MICROWAVE COMMUNICATION EQUIPMENT

Repeater Service Unit MI-31495-A

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TECHNICAL DATA

Power Input:

a. Filament Heaters: 14 watts at 115 v, 50/60 cycles ac

b. Plate Supply: 50 milliamps at 250 v dc

Levels:

a. Transmitting Amp. Input: Voice
Output: 4 volts rms (approx.) across 60,000 ohms

b. Receiving Amp. Input: 5 volts rms (approx.) across 10,000 ohms
Output: Handset

Ringing Frequency:

285 cycles

Fault Signal Frequency:

2800 cycles

Tube Complement

Symbol	*Type*	*Function*
6V1	12AX7	Calling Amplifier
6V2	12AT7	Calling Gate and Fault Lockout Gate
6V3	12AX7	Fault Amplifier
6V4	12AT7	Handset Amplifier and Mike Amplifier
6V5	6AH6	Fault/Ring Oscillator

Weight and Dimensions:

Weight: 16 lbs.
Height: 8¾"
Depth back of panel: 4½"
Depth front of panel: 4"
Width: Standard 19" Rack Mounting

DESCRIPTION

The Repeater Service Unit MI-31495-A is designed for mounting in either a standard 19" open rack or cabinet and is usually used at drop or thru repeater stations. This unit serves to create fault tone signals that are transmitted to the other stations, when the receiver or transmitter is inoperative or other faults develop. These signals when received at a terminal station identify the repeater station sending the signal and the type of fault. The unit also contains facilities for voice communication with any or all of the stations of a microwave system. These signals travel on the same microwave carrier that contains the multiplex channels.

Repeater Service Unit MI-31495-A consists of both a receiving branch and a transmitting branch operating in conjunction with sensing relays and a fault code circuit.

One function of the transmitting branch is to generate and send out pulsed tone signals whenever either repeater transmitter and/or receiver becomes inoperative or when any one of three other station faults develop.

The occurrence of any one of these faults will energize a relay to start a fault signal transmission cycle. It is possible for more than one station fault to be sent during each fault transmission cycle. There are six fault relays, 6K1, the E-W transmitter relay; 6K10 for the W-E transmitter; 6K3, for either receiver/modulator; and three external fault relays 6K4, 6K5, and 6K11. Each of these relays has a contact B which initiates operation of motors 6M1 and 6B1 through contact 6K8C and 6M1A. Motor 6M1 closes contact 6M1B to keep itself operating and opens 6M1A in order to stop 6B1 after it completes one revolution. 6B1 turns the commutator brush arm through one revolution in about 12 seconds, while maintaining its circuit via commutator segment Y. Relay 6K6 is energized when the brush arm contacts a commutator segment connected to its coil. The segments concerned with station identification are connected directly to 6K6, while those concerned with fault identification are connected to 6K6 through the C contacts of their respective fault relays, 6K1, 6K3, 6K4, 6K5, 6K10 and 6K11. Thus in the event of a receiver fault, for example, 6K6 will be operated as the brush arm contacts segment A, since the associated fault relay, 6K3, is operated and its C contact closed. When closed, the contact of relay 6K6 applies the 2800 cycle tone generated by oscillator 6V5 to the transmitted service channel. One set of pulses is transmitted and a second set of pulses cannot be transmitted until 6M1 has completed its cycle about four minutes later, closing 6M1A. The transmitted service channel is fed through filter 6FL2 to the baseband unit and from there to the modulator in the receiver/modulator. The service channel is transmitted on the microwave carrier to all other stations of the system. The 2800 cycle tone pulses on the system operate a commutator brush arm in the terminal station service unit which is in synchronism with the commutator brush arm of the repeater station. The action of the

terminal commutator brushes lights a combination of lamps on an indicator panel which identifies the exact repeater station sending the fault tone and the nature of its trouble.

In a system of 10 repeater stations or less each station has its own two digit fault code number. Code number combinations are available for use when wiring the segments of commutator 6E1 of the service units for their code designations. The 10 two digit code combinations are: 1-2, 1-3, 1-4, 1-5, 2-3, 2-4, 2-5, 3-4, 3-5, 4-5.

In systems of more than 10 stations between terminals the following code combinations can be used to supplement the above: 1-2-3, 1-2-4, 1-2-5, 1-3-4, 1-3-5, 1-4-5, 2-3-4, 2-3-5, 2-4-5, 3-4-5. The segments corresponding to the code numbers and segment Z are wired together as shown in the example in the schematic of figure RS-4.

One of the commutator segments 3, 4 or 5 that is not used for station identification is used to operate relay 6K7 which resets 6K1 or 6K10 which would otherwise "lock up" on a transmitter failure due to the self-locking action of the fault relay employed in the transmitter. Commutator segments A, B, C, D and 6 are used to indicate the particular type of trouble occurring at the station. Segment A is used to indicate receiver failure; B, transmitter failure, and C, D, and 6 may be used for other indications desired by the user. Contacts A of relays 6K1, 6K3 and 6K10 serve no purpose in the equipment described in this book. At standby stations, contact C of 6K1 and 6K10 initiate switchover operation when either relay is operated.

The transmitting portion of the circuit consists of a phase shift type audio oscillator 6V5 which normally oscillates at a frequency of 2800 cycles and is keyed on and off by relay 6K6 to transmit the fault tone pulses. Oscillator 6V5 can also be shifted to a frequency of 285 cycles by the operation of calling pushbutton 6S1. Transmission of this 285 cycle tone activates buzzers in all other service units of the system, and is used as a ringing signal to attract the attention of the other operators. The output of the service telephone plugged into jack 6J2 is amplified by the 6V4B audio stage and is passed together with the ring or fault tone through filter 6FL2 to the communication channel of the relay system. The voltage level to filter 6FL2 from fault oscillator 6V5 is set by OSC OUTPUT control 6R44 and from service telephone amplifier 6V4B by MIKE OUTPUT control 6R48.

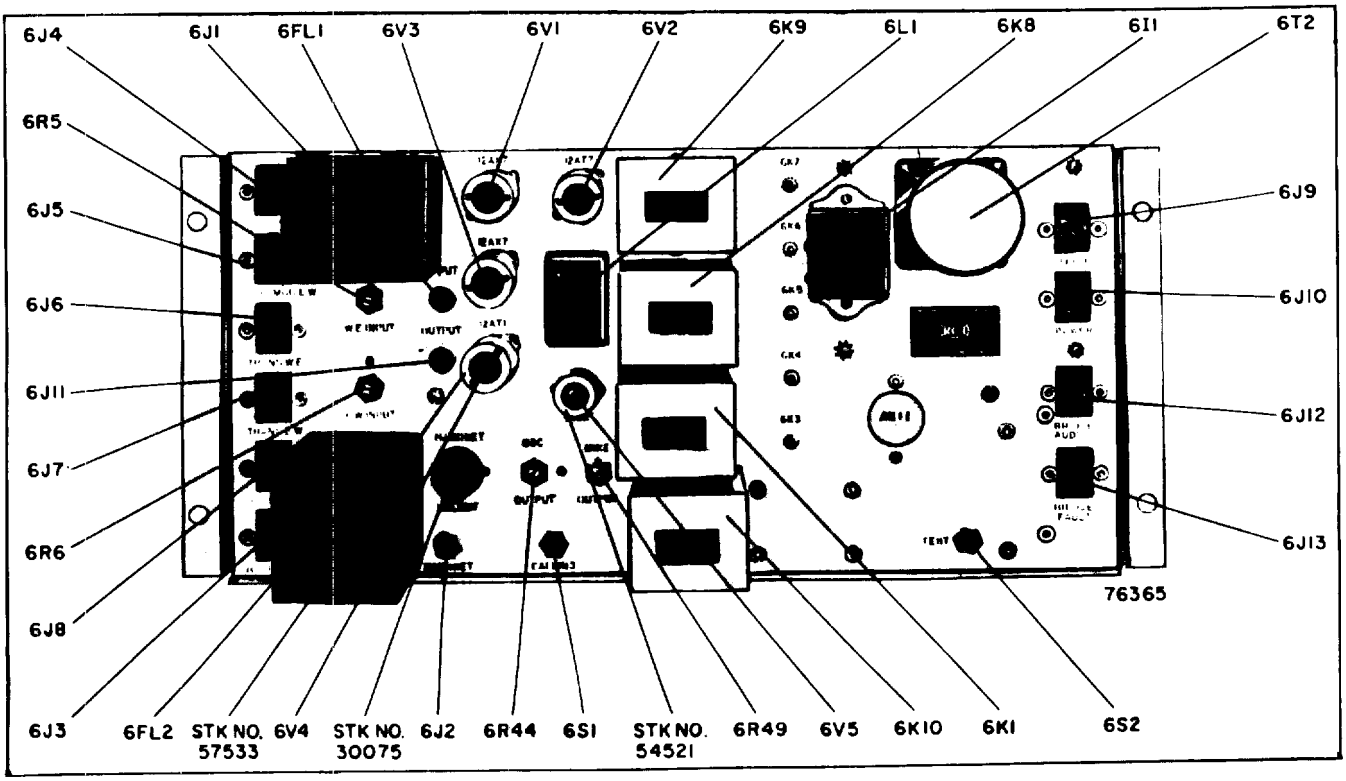


Figure RS-1—Repeater Service Unit, MI-31495-A—Front View

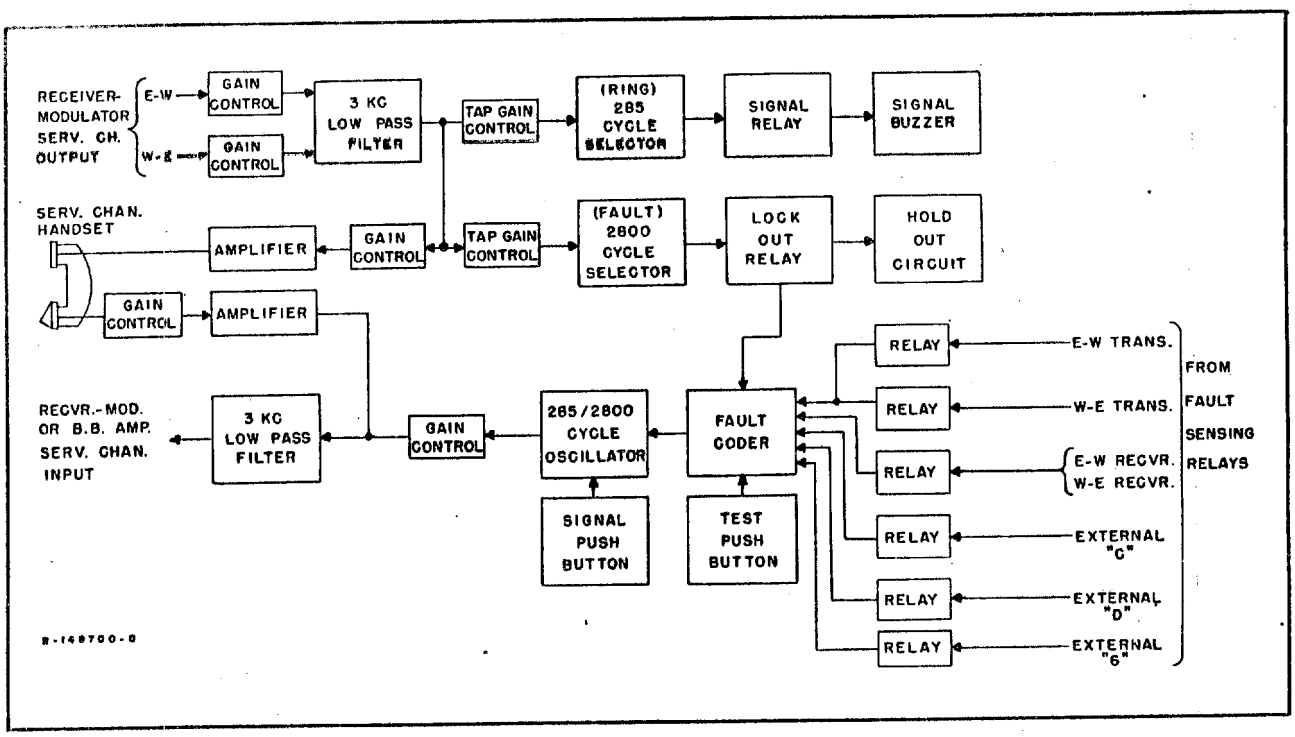


Figure RS-2—Repeater Service Unit—Block Diagram

In the receiving section the fault/ring tone and voice frequencies (300 cycles to 3000 cycles) are received from both the E-W and W-E receivers and passed through a 3000 cycle low pass filter 6FL1 to prevent any multiplex frequencies above 3000 cycles from entering the service unit circuits. W-E INPUT gain control 6R5 and E-W INPUT gain control 6R6 control the voltage level to filter 6FL1 from the W-E and E-W receivers respectively. One circuit fed by this filter is amplifier 6V1, selective to the 285 cycle ring tone, and gate tube 6V2A which controls relay 6K9. This circuit operates a buzzer when a ring tone (285 cycles) is present in the service signal.

A second branch of the receiving section consists of the fault amplifier 6V3, responsive to the 2800 cycle fault tone, gate tube 6V2B and relay 6K8. Reception of a 2800 cycle signal causes relay 6K8 to operate, opening contact 6K8C which prevents the starting of motors 6M1 and 6B1 and consequent fault tone transmission from the station. Since as many as 15 repeater stations may be cascaded in a section of a system it is possible that two or more may attempt to transmit fault signals at the same time. This would result in the appearance of incorrect information at the terminal station. Relay 6K8 therefore prevents a repeater station from starting a fault transmission when any other repeater station is sending a fault tone. In addition relay contact 6K8A by connecting capacitors 6C9A and 6C9B to the 6V2 grid, delays the release of 6K8 for a sufficiently long time to permit the repeater station first sending the fault tone to complete its fault transmission before another station starts its own fault transmission.

The final element of the receiving branch is a cathode follower stage which amplifies the voice frequencies to jack 6J2 for the telephone handset receiver. The handset signal level is set by HANDSET VOLUME control 6R11.

Bridge audio jack 6J12 and bridge fault jack 6J13 are provided to accommodate the addition of MI-31072 Service Channel Bridging at junction stations. MI-31072 permits the use of only one repeater service unit to serve both stations of the junction. Jacks 6J12 and 6J13 provide the means of supplying the fault/ring tones, voice signals and fault code information to the bridging unit and of receiving local fault information from the bridging unit.

CONTROLS

a. The E-W INPUT and W-E INPUT controls (6R6 and 6R5) vary the amplitude of the service channel input to filter, 6FL1, from the E-W and W-E receivers.

b. The HANDSET VOLUME control (6R11) varies the amount of voice signal voltage applied to the grid of handset amplifier 6V4A.

c. The HANDSET jack (6J2) is for connecting the service channel telephone handset.

d. The OSC OUTPUT (6R44) screwdriver control adjusts the level of the ring fault tone oscillator output fed to low pass filter 6FL2.

e. The MIKE OUTPUT screwdriver control (6R49) adjusts the gain of microphone amplifier 6V4B.

f. The CALLING pushbutton (6S1) when pressed changes oscillator 6V5 from a fault tone (2800 cycle) generator to a ring tone (285 cycle) generator and connects this fault/ring tone signal to the low pass output filter 6FL2.

g. The TEST pushbutton (6S2) when pressed causes motors 6M1 and 6B1 to run so that the operation of the fault code circuits may be checked

h. The Variable Tap Resistor, 6R53, reached from the rear of the unit, controls the amount of dc voltage for energizing relays 6K1 and 6K10.

i. The Fault Oscillator Control 6R37 is a screw driver adjusting variable resistor, reached from the rear of the unit, for setting the frequency of oscillator 6V5 to the fault tone frequency of 2800 cycles.

j. The Ring Oscillator Frequency Control 6R41 is a screw driver adjusting variable resistor, reached from the rear of the unit, for setting the frequency of oscillator 6V5 to the tone frequency of 285 cycles. The adjustment is made with the CALLING button pushed.

k. The INPUT pinjack (6J1) is for connecting test leads to a Ballantine Model 300 voltmeter to measure the audio signal voltage output of filter 6FL1.

l. The OUTPUT pinjack (6J11) is for connecting test leads to a Ballantine Model 300 voltmeter to measure the audio signal voltage output of the fault ring tone oscillator 6V5 and microphone amplifier 6V4B.

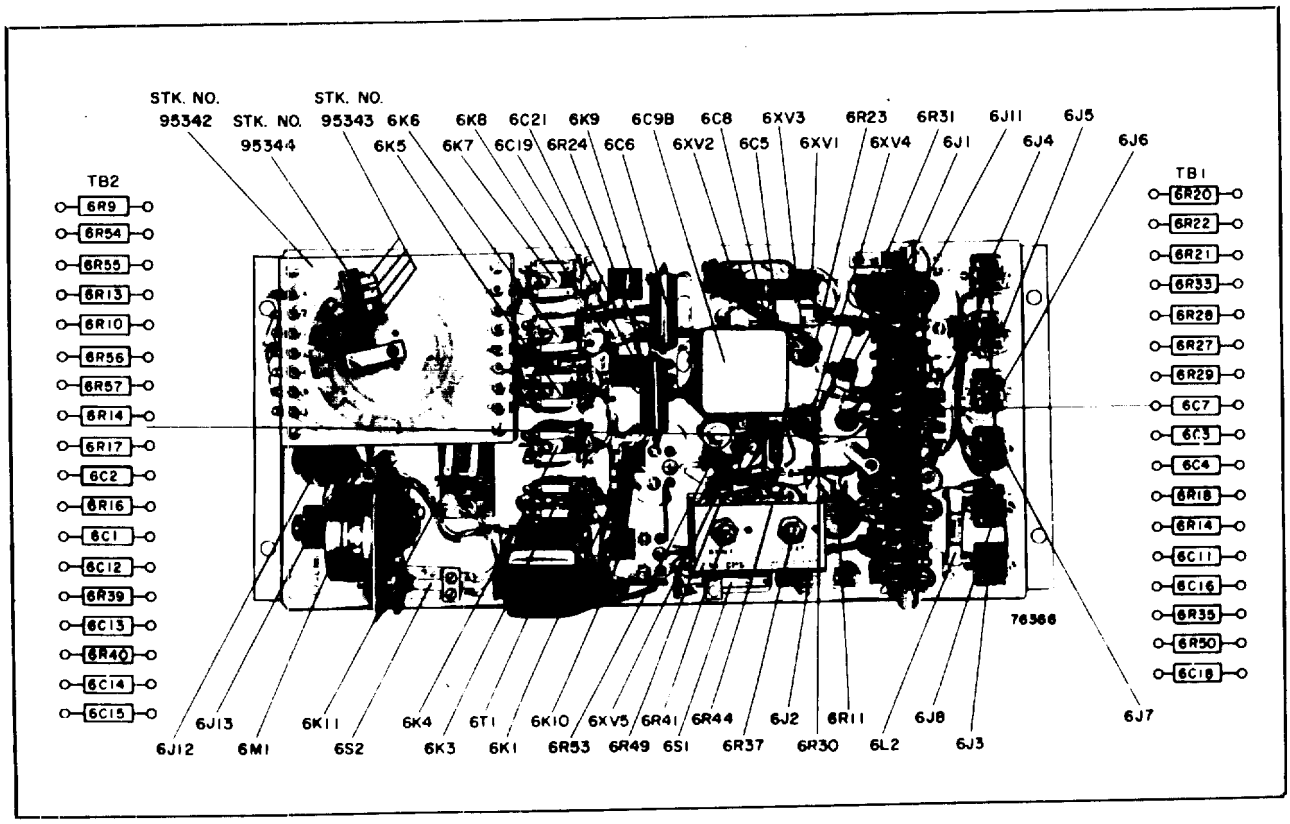


Figure RS-3—Repeater Service Unit, MI 31495-A—Rear View, Dust Cover Removed

MAINTENANCE

General Notes

Fault Relay and Commutator

a. At each routine repeater station inspection, check the operation of the timer motor 6M1 and 6B1 and the commutator brush arm. The timer should take four minutes and the commutator brush arm should take 12 seconds to complete one revolution. When the commutator brushes pass segment "Z" on the commutator, 6K6 should be operated.

b. When faulty commutator contact becomes evident increase the commutator brush pressure as follows:

Loosen the screw holding the brush arm and rotate the arm in the direction that will increase the pressure of the brushes against the commutator plate and then tighten the arm in this position. Be certain that the pressure of the brushes against the segments is sufficient to make positive contact.

c. A check of the proper operation of the commutator assembly 6E1 in conjunction with the terminal fault indicating equipment may be made by simulating each of the five types of faults at the repeater and observing the lamp panel at the terminal station for the proper identifying code. The faults can be simulated by pressing the armature of each of relays 6K1, 6K3, 6K4, 6K5 and 6K11 in turn. Use the maintenance telephone channel for checking the results of the test at the terminal station.

d. Adjust variable resistor 6R53 for a voltage at 6K1 of 113 v with both transmitter output meter relays (1M2) in the condition of having their red and black arms touching (contacts closed).

Input Circuit

a. The normal adjustment of the W-E and E-W INPUT controls, 6R5 and 6R6, is the maximum clockwise position.

b. Excess gain is available in both the calling amplifier and fault amplifiers. If the input voltage to these circuits is too great the connections to the 6R9, 6R54 and 6R55 or the 6R10, 6R56, 6R57 resistance networks may be reduced to a lower tap. The input voltage to the calling amplifier will need to be reduced if the voice signals in the maintenance channel causes the call buzzer to sound.

c. Adjust the HANDSET VOLUME control to the desired listening level.

Output Circuit

The adjustment of the level of the fault and service signals applied to the baseband or receiver/modulator units from the repeater service unit is described as follows:

TYPICAL REPEATER SERVICE UNIT VOLTAGES

The following are typical voltages between various tube pins and ground as read with a vacuum tube voltmeter. All voltages are dc unless otherwise noted.

Tube	*Type*	*Function*	*Pin #1*	*Pin #2*	*Pin #3*	*Pin #4*	*Pin #5*	*Pin #6*	*Pin #7*	*Pin #8*	*Pin #9*
6V1	12AX7	Calling Amp.	250	0	2.5	0	0	140	1.0	2.5	6.3 ac
6V2	12AT7	Calling Gate Fault Lockout	250	0	8.4	0	0	250	1.0	8.4	6.3 ac
6V3	12AX7	Fault Amp.	250	0	2.0	0	0	—	—	—	6.3 ac
6V4	12AT7	Handset - Mike Amp.	250	0	3.0	0	0	90	0	1	6.3 ac
6V5	6AH6	Osc.	0	1.9	6.3 ac	0	150	150	1.9	—	—

Drop Repeater Station

a. The OSC OUTPUT and MIKE OUTPUT adjustments are made as follows:

1. Connect an audio voltmeter (Ballantine Model 300 or equivalent) to pin 6J8-2 and ground.

2. Press the CALLING button and adjust the OSC OUTPUT control for a meter reading of 1.32 volts.

3 Speak into the handset microphone and adjust the MIKE OUTPUT control for a meter reading of from 0.5 to 0.8 volt on voice peaks.

b. The audio output connections must be made at the junction of 6R51 and 6FL2. The specified levels cannot be obtained if the wrong output connection is used.

Thru Repeater Station

a. The OSC OUTPUT and MIKE OUTPUT adjustments are made as follows:

1. Connect the audio voltmeter (Ballantine Model 300 or equivalent) to pin 6J8-2 and ground.

2. Press the CALLING button and adjust the OSC OUTPUT control for a meter reading of 0.057 volt.

3. Speak into the handset microphone and adjust the MIKE OUTPUT control for a meter reading of from 0.023 to 0.035 volt on voice peaks.

b. The audio output connection must be made at the junction of 6R59 and 6R51. Severe overloading of the modulator will result if the wrong output connection is used.

REPLACEMENT PARTS LIST

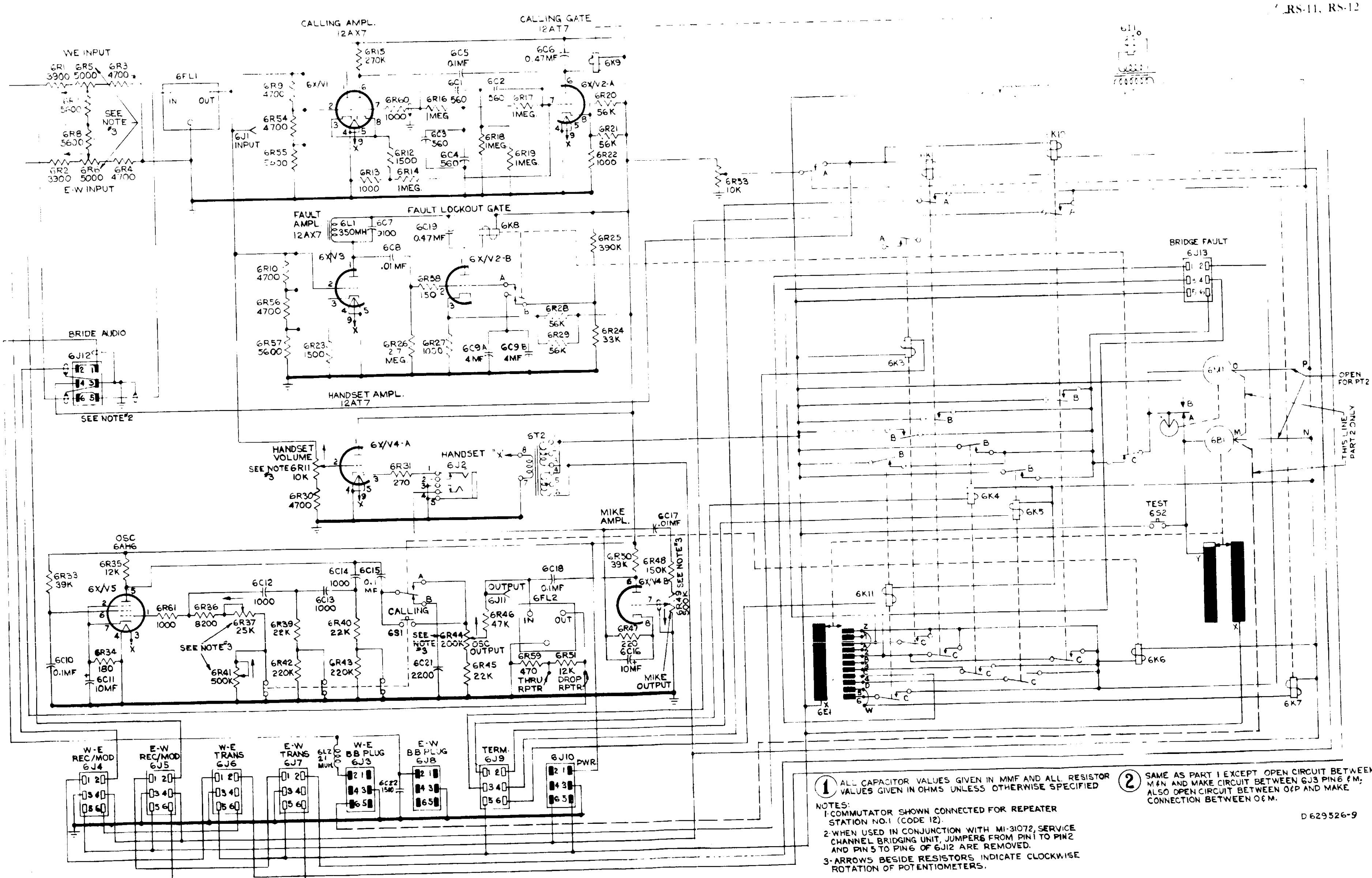
REPEATER SERVICE UNIT—MI-31495-A

Symbol No.	*Description*	*Drawing No.*	*Stock No.*
6B1	Motor, synchronous, clock type, 115 v., 60 cycle	8833318-1	95340
6C1 to 6C4	Capacitor, fixed, mica, 560 mmf ±2%, 500 v.	722022-553	72841
6C5	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v.	735715-175	73551
6C6	Capacitor, fixed, paper, 0.47 mf ±20%, 200 v.	735715-33	73787
6C7	Capacitor, fixed, mica, 9100 mmf ±2%, 300 v.	722029-562	95383
6C8	Capacitor, fixed, paper, 0.01 mf ±10%, 400 v.	735715-163	73561
6C9A, B	Capacitor, fixed, paper, 4.0 mf +20 −10%, 100 v.	8887709-153	95341
6C10	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v. Same as 6C5	735715-175	73551
6C11	Capacitor, dry electrolytic, 10 mf, 25 v.	442901-46	52533
6C12 to 6C14	Capacitor, fixed, mica, 1000 mmf ±2%, 500 v.	722022-559	90003
6C15	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v. Same as 6C5	735715-175	73551
6C16	Capacitor, dry electrolytic, 10 mf, 25 v. Same as 6C11	442901-46	52533
6C17	Capacitor, fixed, paper, 0.01 mf ±10%, 400 v. Same as 6C8	735715-163	73561
6C18	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v. Same as 6C5	735715-175	73551
6C19	Capacitor, fixed, paper, 0.47 mf ±20%, 200 v. Same as 6C6	735715-33	73787
6C20	Not used.		
6C21	Capacitor, fixed, mica, 2200 mmf ±10%, 500 v.	727866-155	39660
6C22	Capacitor, fixed, ceramic, 1500 mmf +100 −0%, 500 v.	449696-3	73748
6E1	Commutator Assembly—(following parts only available)	744080-502	
	Clip, contact brush holding clip	128727-1	95344
	Contact, sliding, for code signal commutator assembly	128746-1	95343
	Plate, repeater code signal commutator plate assembly, complete with contacts and terminals	458943-502	95342

Symbol No.	Description	Drawing No.	Stock No.
6FL1	Filter, low pass, 3.6 to 100 kc/s impedance 5000 ohm input and output	8833307-2	95345
6FL2	Filter, low pass, 3.6 to 100 kc/s impedance 10,000 ohm input and output	8833306-2	95346
6I1	Buzzer, door bell type, 8-12 v., 60 cycle	8848315-1	95347
6J1	Connector, female, pin jack	742565-1	93678
6J2	Connector, female, telephone jack	8845648-1	94232
6J3	Connector, male, 6 contact, chassis mtg.	181494-3	28507
6J4 to 6J7	Connector, female, 6 contact, chassis mtg.	181494-4	18534
6J8	Connector, male, 6 contact, chassis mtg. Same as 6J3	181494-3	28507
6J9	Connector, female, 6 contact, chassis mtg. Same as 6J4	181494-4	18534
6J10	Connector, male, 6 contact, chassis mtg. Same as 6J3	181494-3	28507
6J11	Connector, female, pin jack. Same as 6J1	742565-1	93678
6J12	Connector, male, 6 contact, chassis mtg. Same as 6J3	181494-3	28507
6J13	Connector, female, 6 contact, chassis mtg. Same as 6J4	181494-4	18534
6K1	Relay, dc, coil, 68 v., 3 form "A" make, contacts	174913-8	95348
6K2	Not used.		
6K3	Relay, ac, midget type, coil, 115 v., 50/60 cycle, 3 p.s.t. normally open contacts	458952-2	95349
6K4 to 6K7	Relay, ac, midget type, coil, 115 v., 50/60 cycle, d.p.d.t. contacts	458952-1	95350
6K8	Relay, dc, coil, 72 v., 2 form "C" break-make contacts	174913-7	95351
6K9	Relay, dc, coil, 41 v., 1 form "C" break-make contact	174913-6	95352
6K10	Relay, dc, coil, 68 v., 3 form "A" make contacts	174913-8	95348
6K11	Relay, ac, midget type, coil, 115 v., 50/60 cycle, d.p.d.t. contacts. Same as 6K4	458952-1	95350
6L1	Reactor, iron core, 350 mh	8833309-1	95359
6L2	Reactor, air core, r-f choke, 21 microhenry	8896181-1	57918
6M1	Motor, timer, clock type, 115 v., 60 cycle, with one s.p.d.t. microswitch attached and fixed cam with 6° notch	458949-1	95360
6R1, 6R2	Resistor, fixed, composition, 3900 ohm ±10%, ½ w.	82283-69	502239
6R3, 6R4	Resistor, fixed, composition, 4700 ohm ±10%, ½ w.	82283-70	502247
6R5, 6R6	Resistor, variable, composition, 5000 ohm ±10%, 2 w.	737829-30	94039
6R7, 6R8	Resistor, fixed, composition, 5600 ohm ±10%, ½ w.	82283-71	502256
6R9, 6R10	Resistor, fixed, composition, 4700 ohm ±10%, ½ w. Same as 6R3	82283-70	502247
6R11	Resistor, variable, composition, 10,000 ohm ±10%, 2 w.	737801-43	68833
6R12	Resistor, fixed, composition, 1500 ohm ±10%, ½ w.	82283-64	502456
6R13	Resistor, fixed, composition, 1000 ohm ±10%, ½ w.	82283-62	502210
6R14	Resistor, fixed, composition, 1 meg ±5%, ½ w.	82283-231	502510
6R15	Resistor, fixed, composition, 270,000 ohm ±10%, ½ w.	82283-91	502427
6R16 to 6R19	Resistor, fixed, composition, 1 meg ±5%, ½ w. Same as 6R14	82283-231	502510
6R20, 6R21	Resistor, fixed, composition, 56,000 ohm ±10%, ½ w.	99126-83	28741

Symbol No.	*Description*	*Drawing No.*	*Stock No.*
6R22	Resistor, fixed, composition, 1000 ohm ±5%, 1 w.	90496-159	512210
6R23	Resistor, fixed, composition, 1500 ohm ±10%, ½ w. Same as 6R12	82283-64	502456
6R24	Resistor, fixed, composition, 33,000 ohm ±10%, ½ w.	82283-80	502333
6R25	Resistor, fixed, composition, 390,000 ohm ±10%, 1 w.	90496-93	32725
6R26	Resistor, fixed, composition, 2.7 meg ±10%, ½ w.	82283-103	72788
6R27	Resistor, fixed, composition, 1000 ohm ±5%, 1 w. Same as 6R22	90496-159	512210
6R28, 6R29	Resistor, fixed, composition, 56,000 ohm ±10%, ½ w. Same as 6R20	99126-83	28741
6R30	Resistor, fixed, composition, 4700 ohm ±10%, ½ w. Same as 6R3	82283-70	502247
6R31	Resistor, fixed, composition, 270 ohm ±10%, ½ w.	82283-55	30929
6R32	Not used.		
6R33	Resistor, fixed, composition, 39,000 ohm ±10%, 1 w.	90496-81	71084
6R34	Resistor, fixed, composition, 180 ohm ±10%, 1 w.	735730-53	502118
6R35	Resistor, fixed, composition, 12,000 ohm ±10%, 2 w.	99126-185	522312
6R36	Resistor, fixed, composition, 8200 ohm ±5%, ½ w.	82283-181	502282
6R37	Resistor, variable, composition, 25,000 ohm ±10%, 2 w.	737854-4	95367
6R38	Not used.		
6R39, 6R40	Resistor, fixed, composition, 22,000 ohm ±5%, ½ w.	82283-191	502322
6R41	Resistor, variable, composition, 500,000 ohm ±10%, 2 w	737854-5	95368
6R42, 6R43	Resistor, fixed, composition, 220,000 ohm ±5%, ½ w.	82283-215	502422
6R44	Resistor, variable, composition, 200,000 ohm ±10%, 2 w.	737854-6	95369
6R45	Resistor, fixed, composition, 22,000 ohm ±10%, ½ w.	727834-78	502322
6R46	Resistor, fixed, composition, 47,000 ohm ±10%, ½ w.	82283-82	502347
6R47	Resistor, fixed, composition, 220 ohm ±10%, ½ w.	82283-54	502122
6R48	Resistor, fixed, composition, 15,000 ohm ±10%, ½ w.	82283-88	502415
6R49	Resistor, variable, composition, 500,000 ohm ±10%, 2 w. Same as 6R41	737854-5	95368
6R50	Resistor, fixed, composition, 39,000 ohm ±10%, 1 w. Same as 6R33	90496-81	71084
6R51	Resistor, fixed, composition, 12,000 ohm ±5%,, ½ w.	82283-185	502312
6R52	Not used.		
6R53	Resistor, adj. wire wound, 10,000 ohms ±10%, 25 w.	449695-6	202931
6R54	Resistor, fixed, composition, 4700 ohm ±10%, ½ w. Same as 6R3	82283-70	502247
6R55	Resistor, fixed, composition, 5600 ohm ±10%, ½ w. Same as 6R7	82283-71	502256
6R56	Resistor, fixed, composition, 4700 ohm ±10%, ½ w. Same as 6R3	82283-70	502247
6R57	Resistor, fixed, composition, 5600 ohm ±10%, ½ w. Same as 6R7	82283-71	502256
6R58	Resistor, fixed, composition, 130 ohm, ±10%, ½ w.	82283-52	502115
6R59	Resistor, fixed, composition, 470 ohm ±10%, ½ w.	727834-58	30499
6R60	Resistor, fixed, composition, 1000 ohm ±10%, ½ w. Same as 6R13	82283-62	502210
6R61	Resistor, fixed, composition, 1000 ohm ±10%, ½ w.	735730-62	502210
6S1	Switch, push leaf type, non-locking, 3 break, 1 make contacts with black bakelite button	458953-3	95370

Symbol No.	*Description*	*Drawing No.*	*Stock No.*
6S2	Switch, push leaf type, non-locking, break-make contact, with black bakelite button	458953-1	95386
6S3	Switch, snap action, bakelite case, s.p.d.t. contacts	8810605-1	97447
6T1	Transformer, bell ringing	458947-1	95371
6T2	Transformer, filament	949385-1	94196
6X1 to 6X4	Socket, tube, 9 pin miniature	984055-2	56333
6X5	Socket, tube, 7 pin miniature	99370-2	53539
	Miscellaneous		
	Knob, round bakelite (for 6R11)	712336-507	30075
	Screw, thumb, brass, back cover holding	8886111-2	94391
	Shield, tube, 7 pin miniature type	99369-2	54521
	Shield, tube, 9 pin miniature type	8858642-3	57533



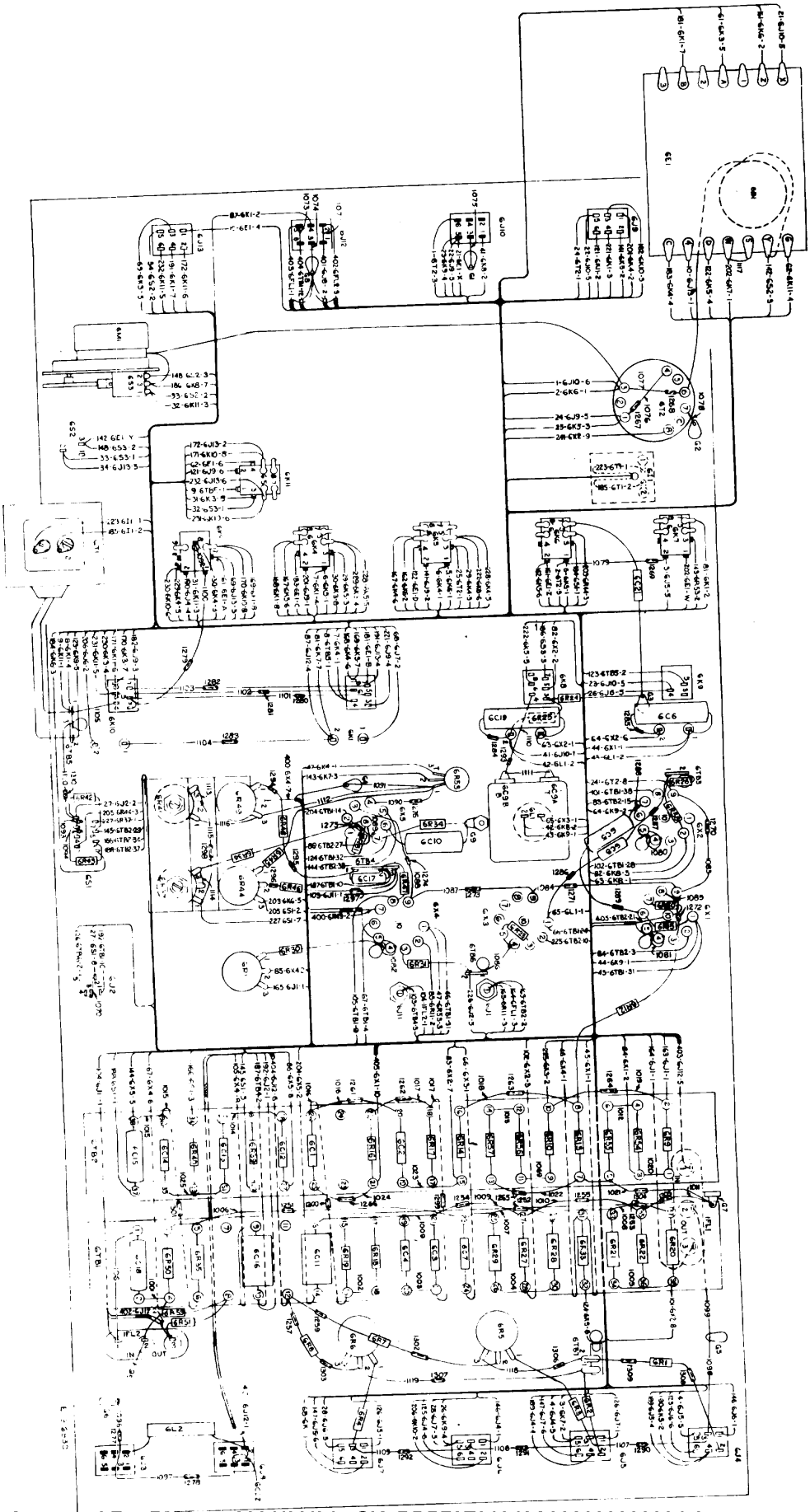
1. ALL CAPACITOR VALUES GIVEN IN MMF AND ALL RESISTOR VALUES GIVEN IN OHMS UNLESS OTHERWISE SPECIFIED

NOTES:
1-COMMUTATOR SHOWN CONNECTED FOR REPEATER STATION NO.1 (CODE 12).
2-WHEN USED IN CONJUNCTION WITH MI-31072, SERVICE CHANNEL BRIDGING UNIT, JUMPERS FROM PIN 1 TO PIN 2 AND PIN 5 TO PIN 6 OF 6J12 ARE REMOVED.
3-ARROWS BESIDE RESISTORS INDICATE CLOCKWISE ROTATION OF POTENTIOMETERS.

2. SAME AS PART 1 EXCEPT OPEN CIRCUIT BETWEEN M & N AND MAKE CIRCUIT BETWEEN 6J3 PIN 6 & M; ALSO OPEN CIRCUIT BETWEEN O & P AND MAKE CONNECTION BETWEEN O & M.

D629526-9

Figure RS-4—Repeater Service Unit, MI-31495-A—Schematic Diagram



WIRE TABLE						
WIRE NO. INCLUSIVE	DESCRIPTION COLOR AND CONDUCTOR		ITEM NO.	PS NO. OR DRAWING NO.	8833 314-552	
	WHITE	7/00				
2-54	WHT-BLK	1		PS724-1		
41-47	RED		61			
48-49	BLU		62			
50-69	YEL		63			
81-82	GRN		64			
101-126	RED/BLK		65			
141-148	RED/BLU		66			
161-172	BLK/GRN		81			
181-182	YEL/RED		82			
201-206	YEL/BLK		83	PS724-...		
221-232	YEL GRN	7/00	84	PS724-1		
241	BRN/GRN	14/00	85	PS724-3		
400-405	WHT CABLE SHIELDED		87	8885679		
501-509	TINNED COPPER WIRE .032 DIA		88	PS702		
251-510	BLK NO TUBING	.042 I.D.	89	PS702		

WIRE NOS NOT USED
256, 258, 340

NOTES: DESIGNATION OF WIRE ARE WIRE NOS AND WIRE DESTINATION
ELECTRICAL CONNECTIONS SHALL BE MADE BY SOLDERING
SOLDER IN ACCORDANCE WITH RCA STANDARD PRACTICE.
3 CABLE ASSEMBLY LACE USING LACING CORD ITEM 88
4 CONNECTION SHOWN BY A DOT ON THE ENDS INDICATE THAT THESE CONNECTIONS ARE MADE BY ONE PIECE OF WIRE

Figure RS-5—Repeater Service Unit, MI-31495-A—Connection Diagram

B

MICROWAVE COMMUNICATION EQUIPMENT

Repeater Service Unit MI-31495-C

- TECHNICAL DATA
- DESCRIPTION
- MAINTENANCE
- REPLACEMENT PARTS

RADIO CORPORATION OF AMERICA
COMMERCIAL ELECTRONIC PRODUCTS, CAMDEN, N. J.

PRINTED IN U. S. A.
DU 567

IB-33231-3

TECHNICAL DATA

Power Input:

a. Filament Heaters: 14 watts at 115 v, 50/60 cycles ac

b. Plate Supply:50 milliamps at 250 v dc

Levels:

a. Transmitting Amp. Input: Voice
Output: 4 volts rms (approx.) across 60,000 ohms

b. Receiving Amp. Input: 5 volts rms (approx.) across 10,000 ohms
Output: Handset

Ringing Frequency:

285 cycles

Fault Signal Frequency:

2800 cycles

Tube Complement

Symbol	*Type*	*Function*
6V1	12AX7	Calling Amplifier
6V2	12AT7	Calling Gate and Fault Lock-out Gate
6V3	12AX7	Fault Amplifier
6V4	12AT7	Handset Amplifier and Mike Amplifier
6V5	6AH6	Fault/Ring Oscillator

Weight and Dimensions:

Weight: 16 lbs.
Height: 8¾"
Depth back of panel: 4½"
Depth front of panel: 4"
Width: Standard 19" Rack Mounting

DESCRIPTION

The Repeater Service Unit is designed for mounting in either a standard 19" open rack or cabinet and is usually used at drop or thru repeater stations. This unit serves to create fault tone signals that are transmitted to the other stations, when the receiver or transmitter is inoperative or other faults develop. These signals when received at a terminal station identify the repeater station sending the signal and the type of fault. The unit also contains facilities for voice communication with any or all of the stations of a microwave system. These signals travel on the same microwave carrier that contains the multiplex channels.

Repeater Service Unit consists of both a receiving branch and a transmitting branch operating in conjunction with sensing relays and a fault code circuit.

One function of the transmitting branch is to generate and send out pulsed tone signals whenever either repeater transmitter and/or receiver becomes inoperative or when any one of three other station faults develop.

The occurrence of any one of these faults will energize a relay to start a fault signal transmission cycle. It is possible for more than one station fault to be sent during each fault transmission cycle. There are six fault relays, 6K1, the E-W transmitter relay; 6K10 for the W-E transmitter; 6K3, for either receiver/modulator; and three external fault relays 6K4, 6K5, and 6K11. Each of these relays has a contact B which initiates operation of motors 6M1 and 6B1 through contact 6K8C and 6M1A. Motor 6M1 closes contact 6M1B to keep itself operating and opens 6M1A in order to stop 6B1 after it completes one revolution. 6B1 turns the commutator brush arm through one revolution in about 12 seconds, while maintaining its circuit via commutator segment Y. Relay 6K6 is energized when the brush arm contacts a commutator segment connected to its coil. The segments concerned with station identification are connected directly to 6K6, while those concerned with fault identification are connected to 6K6 through the C contacts of their respective fault relays, 6K1, 6K3, 6K4, 6K5, 6K10 and 6K11. Thus in the event of a receiver fault, for example, 6K6 will be operated as the brush arm contacts segment A, since the associated fault relay, 6K3, is operated and its C contact closed. When closed, the contact of relay 6K6 applies the 2800 cycle tone generated by oscillator 6V5 to the transmitted service channel. One set of pulses is transmitted and a second set of pulses cannot be transmitted until 6M1 has completed its cycle about four minutes later, closing 6M1A. The transmitted service channel is fed through filter 6FL2 to the baseband unit and from there to the modulator in the receiver/modulator at a drop repeater station or directly from 6FL2 to the modulator at a thru repeater station. The service channel is transmitted on the microwave carrier to all other stations of the system. The 2800 cycle tone pulses on the system operate a commutator brush arm in the terminal station service unit which is in synchronism with the commutator brush arm of the repeater station. The action of the

terminal commutator brushes lights a combination of lamps on an indicator panel which identifies the exact repeater station sending the fault tone and the nature of its trouble.

In a system of 10 repeater stations or less each station has its own two digit fault code number. Code number combinations are available for use when wiring the segments of commutator 6E1 of the service units for their code designations. The 10 two digit code combinations are: 1-2, 1-3, 1-4, 1-5, 2-3, 2-4, 2-5, 3-4, 3-5, 4-5.

In systems of more than 10 stations between terminals the following code combinations can be used to supplement the above: 1-2-3, 1-2-4, 1-2-5, 1-3-4, 1-3-5, 1-4-5, 2-3-4, 2-3-5, 2-4-5, 3-4-5. The segments corresponding to the code numbers and segment Z are wired together as shown in the example in the schematic of figure RS-4.

One of the commutator segments that is not used for station identification is used to operate relay 6K7 which resets 6K1 or 6K10 which would otherwise "lock up" on a transmitter failure due to the self-locking action of the fault relay employed in the transmitter. Commutator segments A, B, C, D and 6 are used to indicate the particular type of trouble occurring at the station. Segment A is used to indicate receiver failure; B, transmitter failure, and C, D, and 6 may be used for other indications desired by the user. Contacts A of relays 6K1, 6K3 and 6K10 serve no purpose in the equipment described in this book. At standby stations, contact C of 6K1 and 6K10 initiate switchover operation when either relay is operated.

The transmitting portion of the circuit consists of a phase shift type audio oscillator 6V5 which normally oscillates at a frequency of 2800 cycles and is keyed on and off by relay 6K6 to transmit the fault tone pulses. Oscillator 6V5 can also be shifted to a frequency of 285 cycles by the operation of calling pushbutton 6S1. Transmission of this 285 cycle tone activates buzzers in all other service units of the system, and is used as a ringing signal to attract the attention of the other operators. The output of the service telephone plugged into jack 6J2 is amplified by the 6V4B audio stage and is passed together with the ring or fault tone through filter 6FL2 to the communication channel of the relay system. The voltage level to filter 6FL2 from fault oscillator 6V5 is set by OSC OUTPUT control 6R44 and from service telephone amplifier 6V4B by MIKE OUTPUT control 6R49.

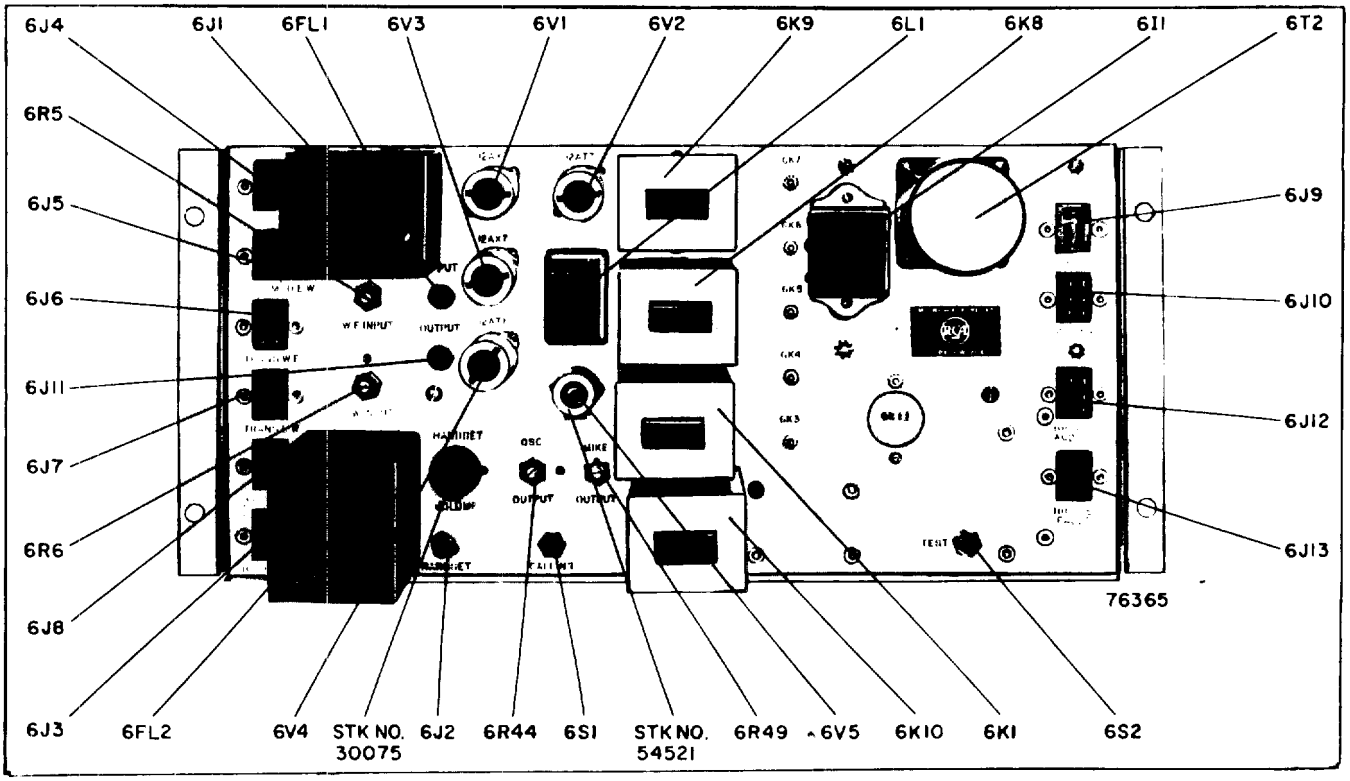


Figure RS-1—Repeater Service Unit—Front View

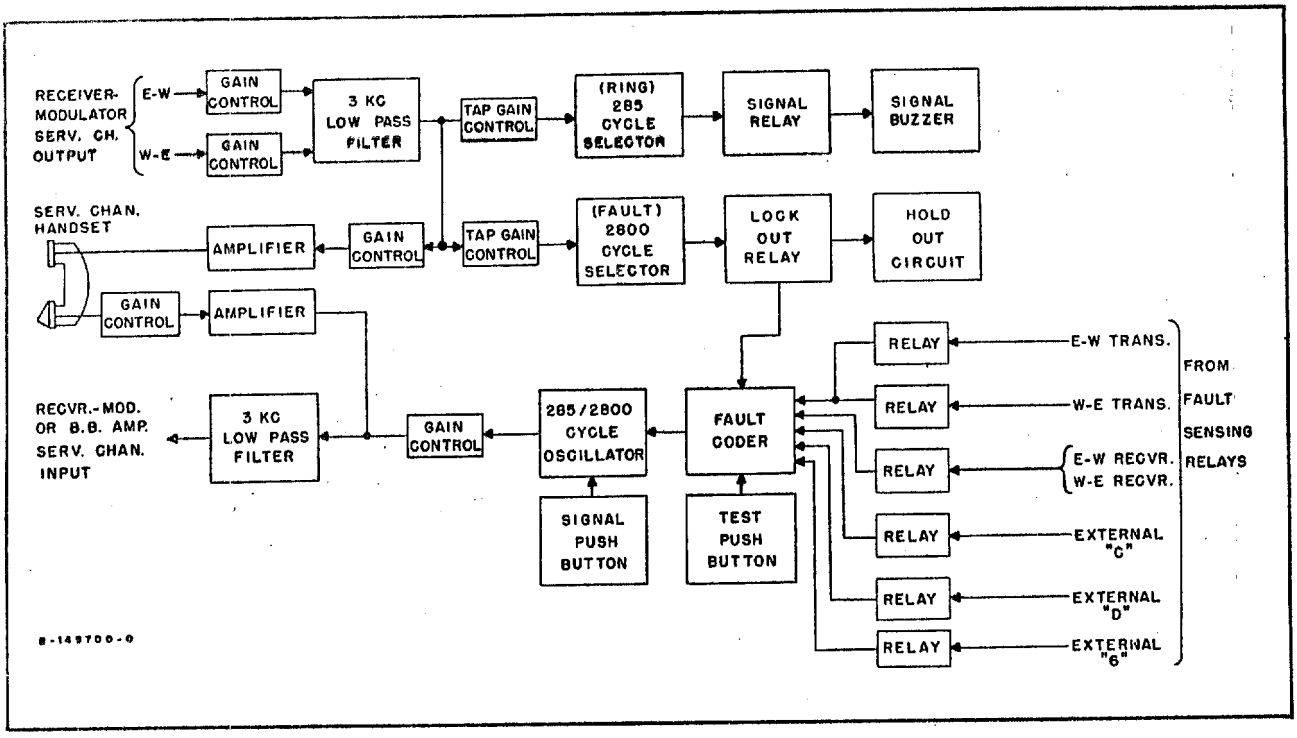


Figure RS-2—Repeater Service Unit—Block Diagram

In the receiving section the fault/ring tone and voice frequencies (300 cycles to 3000 cycles) are received from both the E-W and W-E receivers and passed through a 3000 cycle low pass filter 6FL1 to prevent any multiplex frequencies above 3000 cycles from entering the service unit circuits. W-E INPUT gain control 6R5 and E-W INPUT gain control 6R6 control the voltage level to filter 6FL1 from the W-E and E-W receivers respectively. One circuit fed by this filter is amplifier 6V1, selective to the 285 cycle ring tone, and gate tube 6V2A which controls relay 6K9. This circuit operates a buzzer when a ring tone (285 cycles) is present in the service signal.

A second branch of the receiving section consists of the fault amplifier 6V3, responsive to the 2800 cycle fault tone, gate tube 6V2B and relay 6K8. Reception of a 2800 cycle signal causes relay 6K8 to operate, opening contact 6K8C which prevents the starting of motors 6M1 and 6B1 and consequent fault tone transmission from the station. Since as many as 15 repeater stations may be cascaded in a section of a system it is possible that two or more may attempt to transmit fault signals at the same time. This would result in the appearance of incorrect information at the terminal station. Relay 6K8 therefore prevents a repeater station from starting a fault transmission when any other repeater station is sending a fault tone. In addition relay contact 6K8A by connecting capacitors 6C9A and 6C9B to the 6V2 grid, delays the release of 6K8 for a sufficiently long time to permit the repeater station first sending the fault tone to complete its fault transmission before another station starts its own fault transmission.

The final element of the receiving branch is a cathode follower stage which amplifies the voice frequencies to jack 6J2 for the telephone handset receiver. The handset signal level is set by HANDSET VOLUME control 6R11.

Bridge audio jack 6J12 and bridge fault jack 6J13 are provided to accommodate the addition of a Service Channel Bridging Unit at junction stations. The service channel bridge permits the use of only one repeater service unit to serve both stations of the junction. Jacks 6J12 and 6J13 provide the means of supplying the fault/ring tones, voice signals and fault code information to the bridging unit and of receiving local fault information from the bridging unit.

CONTROLS

a. The E-W INPUT and W-E INPUT controls (6R6 and 6R5) vary the amplitude of the service channel input to filter, 6FL1, from the E-W and W-E receivers.

b. The HANDSET VOLUME control (6R11) varies the amount of voice signal voltage applied to the grid of handset amplifier 6V4A.

c. The HANDSET jack (6J2) is for connecting the service channel telephone handset.

d. The OSC OUTPUT (6R44) screwdriver control adjusts the level of the ring/fault tone oscillator output fed to low pass filter 6FL2.

e. The MIKE OUTPUT screwdriver control (6R49) adjusts the gain of microphone amplifier 6V4B.

f. The CALLING pushbutton (6S1) when pressed changes oscillator 6V5 from a fault tone (2800 cycle) generator to a ring tone (285 cycle) generator and connects this fault ring tone signal to the low pass output filter 6FL2.

g. The TEST pushbutton (6S2) when pressed causes motors 6M1 and 6B1 to run so that the operation of the fault code circuits may be checked

h. The Variable Tap Resistor, 6R53, reached from the rear of the unit, controls the amount of dc voltage for energizing relays 6K1 and 6K10.

i. The Fault Oscillator Control 6R37 is a screw driver adjusting variable resistor, reached from the rear of the unit, for setting the frequency of oscillator 6V5 to the fault tone frequency of 2800 cycles.

j. The Ring Oscillator Frequency Control 6R41 is a screw driver adjusting variable resistor, reached from the rear of the unit, for setting the frequency of oscillator 6V5 to the tone frequency of 285 cycles. The adjustment is made with the CALLING button pushed.

k. The INPUT pinjack (6J1) is for connecting test leads to a Ballantine Model 300 voltmeter to measure the audio signal voltage output of filter 6FL1.

l. The OUTPUT pinjack (6J11) is for connecting test leads to a Ballantine Model 300 voltmeter to measure the audio signal voltage output of the fault/ring tone oscillator 6V5 and microphone amplifier 6V4B.

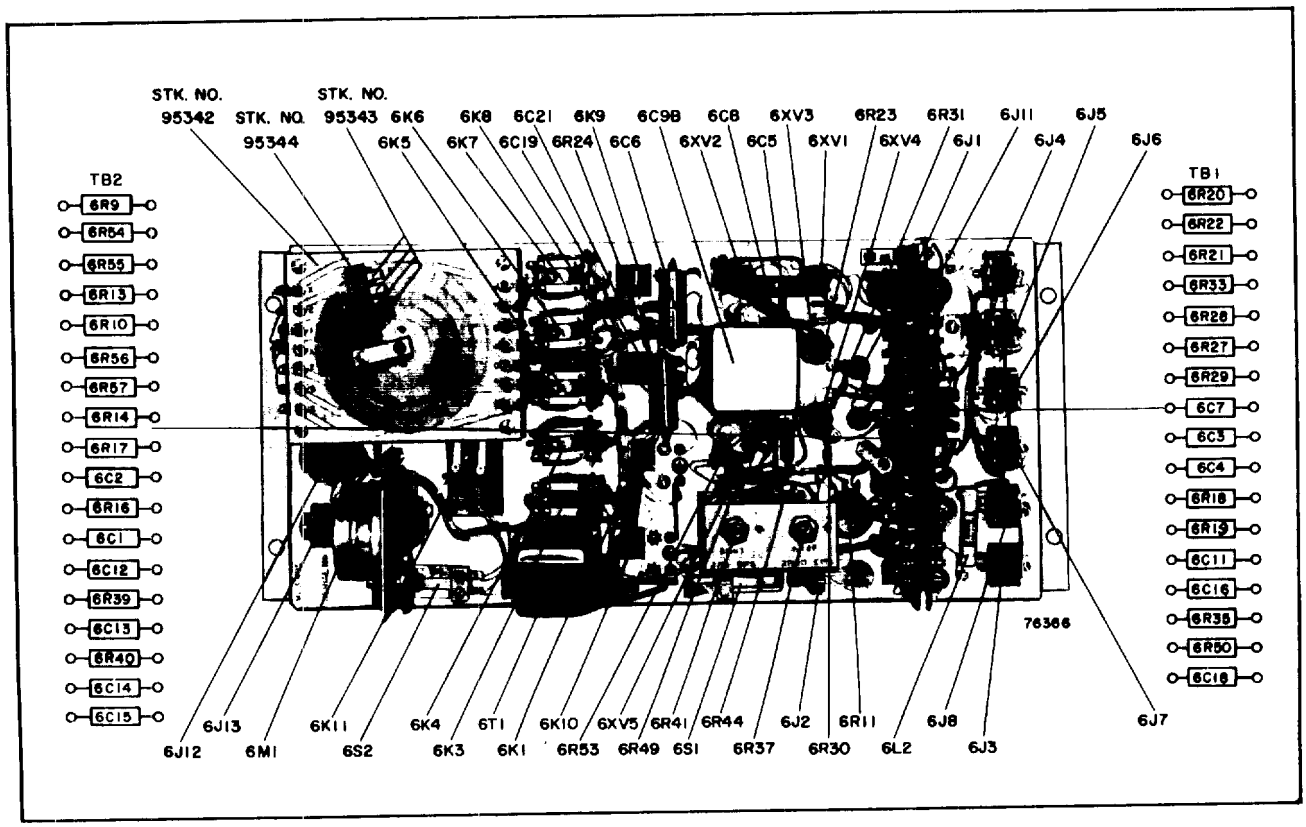


Figure RS-3—Repeater Service Unit—Rear View, Dust Cover Removed

MAINTENANCE

General Notes

Fault Relay and Commutator

a. At each routine repeater station inspection, check the operation of the timer motor 6M1 and 6B1 and the commutator brush arm. The timer should take four minutes and the commutator brush arm should take 12 seconds to complete one revolution. When the commutator brushes pass segment "Z" on the commutator, 6K6 should be operated.

b. When faulty commutator contact becomes evident increase the commutator brush pressure as follows:

Loosen the screw holding the brush arm and rotate the arm in the direction that will increase the pressure of the brushes against the commutator plate and then tighten the arm in this position. Be certain that the pressure of the brushes against the segments is sufficient to make positive contact.

c. A check of the proper operation of the commutator assembly 6E1 in conjunction with the terminal fault indicating equipment may be made by simulating each of the five types of faults at the repeater and observing the lamp panel at the terminal station for the proper identifying code. The faults can be simulated by pressing the armature of each of relays 6K1, 6K3, 6K4, 6K5, 6K10 and 6K11 in turn. Use the maintenance telephone channel for checking the results of the test at the terminal station.

d. Adjust variable resistor 6R53 for a voltage at 6K1 of 113 v with both transmitter output meter relays (1M2) in the condition of having their red and black arms touching (contacts closed).

Input Circuit

a. The normal adjustment of the W-E and E-W INPUT controls, 6R5 and 6R6, is the maximum clockwise position.

b. Excess gain is available in both the calling amplifier and fault amplifiers. If the input voltage to these circuits is too great the connections to the 6R9, 6R54 and 6R55 or the 6R10, 6R56, 6R57 resistance networks may be reduced to a lower tap. The input voltage to the calling amplifier will need to be reduced if the voice signals in the maintenance channel causes the call buzzer to sound.

c. Adjust the HANDSET VOLUME control to the desired listening level.

Output Circuit

The adjustment of the level of the fault and service signals applied to the baseband or receiver/modulator units from the repeater service unit is described as follows:

TYPICAL REPEATER SERVICE UNIT VOLTAGES

The following are typical voltages between various tube pins and ground as read with a vacuum tube voltmeter. All voltages are dc unless otherwise noted.

Tube	*Type*	*Function*	*Pin #1*	*Pin #2*	*Pin #3*	*Pin #4*	*Pin #5*	*Pin #6*	*Pin #7*	*Pin #8*	*Pin #9*
6V1	12AX7	Calling Amp.	250	0	2.5	0	0	150	1.0	2.5	6.3 ac
6V2	12AT7	Calling Gate Fault Lockout	250	0	8.4	0	0	250	1.0	8.4	6.3 ac
6V3	12AX7	Fault Amp.	250	0	2.0	0	0	—	—	—	6.3 ac
6V4	12AT7	Handset - Mike Amp.	250	0	4.0	0	0	80	0	1	6.3 ac
6V5	6AH6	Osc.	0	1.9	6.3 ac	6.3 ac	150	150	1.9	—	—

Drop Repeater Station

a. The OSC OUTPUT and MIKE OUTPUT adjustments are made as follows:

1. Connect an audio voltmeter (Ballantine Model 300 or equivalent) to pin 6J8-2 and ground.

2. Press the CALLING button and adjust the OSC OUTPUT control for a meter reading of:

(a) 1.32 volts when used with Baseband Unit MI-31493.

(b) 0.325 volts when used with Baseband Unit MI-31120 or MI-31910.

3. Speak into the handset microphone and adjust the MIKE OUTPUT control for a meter reading of from:

(a) 0.5 to 0.8 volts when used with Baseband Unit MI-31493.

(b) 0.12 to 0.2 volts when used with Baseband Unit MI-31120 or MI-31910.

b. At stations where Baseband Unit MI-31493 is used, the repeater service unit output connection is to be made at the junction of 6R63 and the "OUT" terminal of 6FL2. At stations where Baseband Unit MI-31120 or MI-31910 is used, the repeater service unit output connection is to be made at the junction of 6R63 and 6R62. The specified levels cannot be obtained if the wrong output connection is used.

Thru Repeater Station

a. The OSC OUTPUT and MIKE OUTPUT adjustments are made as follows:

1. Connect the audio voltmeter (Ballantine Model 300 or equivalent) to pin 6J8-2 and ground.

2. Press the CALLING button and adjust the OSC OUTPUT control for a meter reading of 0.057 volt.

3. Speak into the handset microphone and adjust the MIKE OUTPUT control for a meter reading of from 0.023 to 0.035 volt on voice peaks.

b. The audio output connection must be made at the junction of 6R59 and 6R62. Severe overloading of the modulator will result if the wrong output connection is used.

REPLACEMENT PARTS LIST

Symbol No.	*Description*	*Drawing No.*	*Stock No.*
6B1	Motor, synchronous, clock type, 115 v., 60 cycle	8833318-1	95340
6C1 to 6C4	Capacitor, fixed, mica, 560 mmf ±2%, 500 v.	722022-553	72841
6C5	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v.	735715-175	73551
6C6	Capacitor, fixed, paper, 0.47 mf ±20%, 200 v.	735715-33	73787
6C7	Capacitor, fixed, mica, 9100 mmf ±2%, 300 v.	722029-562	95383
6C8	Capacitor, fixed, mica, 10,000 mmf ±20%, 300 v.	727865-71	92036
6C9A, B	Capacitor, fixed, paper, 4.0 mf +20 −10%, 100 v.	8887709-153	95341
6C10	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v. Same as 6C5	735715-175	73551
6C11	Capacitor, dry electrolytic, 10 mf, 25 v.	442901-46	52533
6C12 to 6C14	Capacitor, fixed, mica, 220 mmf ±2%, 500 v.	727853-331	71014
6C15	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v. Same as 6C5	735715-175	73551
6C16	Capacitor, dry electrolytic, 10 mf, 25 v. Same as 6C11	442901-46	52533
6C17	Capacitor, fixed, paper, 0.01 mf ±10%, 400 v.	735715-163	73561
6C18	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v. Same as 6C5	735715-175	73551
6C19	Capacitor, fixed, paper, 0.47 mf ±20%, 200 v. Same as 6C6	735715-33	73787
6C20	Not used.		
6C21	Capacitor, fixed, mica, 2200 mmf ±10%, 500 v.	727866-155	39660
6C22	Capacitor, fixed, ceramic, 1500 mmf +100 −0%, 500 v.	449696-3	73748

Symbol No.	Description	Drawing No.	Stock No.
6E1	Commutator Assembly—(following parts only available)	744080-502	
	Clip, contact brush holding clip (Part of 6E1)	128727-1	95344
	Contact, sliding, for code signal commutator assembly (Part of 6E1)	128746-1	95343
	Plate, repeater code signal commutator plate assembly, complete with contacts and terminals (Part of 6E1)	458943-502	95342
6FL1	Filter, low pass, 3.6 to 100 kc/s impedance 5000 ohm input and output	8833307-2	95345
6FL2	Filter, low pass, 3.6 to 100 kc/s impedance 10,000 ohm input and output	8833306-2	95346
6I1	Buzzer, door bell type, 8-12 v., 60 cycle	8848315-3	95347
6J1	Connector, female, pin jack	742565-1	93678
6J2	Connector, female, telephone jack	8845648-1	94232
6J3	Connector, male, 6 contact, chassis mtg.	181494-3	28507
6J4 to 6J7	Connector, female, 6 contact, chassis mtg.	181494-4	18534
6J8	Connector, male, 6 contact, chassis mtg. Same as 6J3	181494-3	28507
6J9	Connector, female, 6 contact, chassis mtg. Same as 6J4	181494-4	18534
6J10	Connector, male, 6 contact, chassis mtg. Same as 6J3	181494-3	28507
6J11	Connector, female, pin jack. Same as 6J1	742565-1	93678
6J12	Connector, male, 6 contact, chassis mtg. Same as 6J3	181494-3	28507
6J13	Connector, female, 6 contact, chassis mtg. Same as 6J4	181494-4	18534
6K1	Relay, dc, coil, 68 v., 3 form "A" make, contacts	174913-8	95348
6K2	Not used.		
6K3	Relay, ac, midget type, coil, 115 v., 50/60 cycle, 3 p.s.t. normally open contacts	458952-2	95349
6K4 to 6K7	Relay, ac, midget type, coil, 115 v., 50/60 cycle, d.p.d.t. contacts	458952-1	95350
6K8	Relay, dc, coil, 72 v., 2 form "C" break-make contacts	174913-7	95351
6K9	Relay, dc, coil, 41 v., 1 form "C" break-make contact	174913-6	95352
6K10	Relay, dc, coil, 68 v., 3 form "A" make contacts. Same as 6K1	174913-8	95348
6K11	Relay, ac, midget type, coil, 115 v., 50/60 cycle, d.p.d.t. contacts. Same as 6K4	458952-1	95350
6L1	Reactor, iron core, 350 mh at 35 ma	8833309-1	95359
6L2	Reactor, air core, r-f choke, 21 microhenry, 600 ma, 20-60 mc	8896181-1	57918
6M1	Motor, timer, clock type, 115 v., 60 cycle, with one s.p.d.t. microswitch attached and fixed cam with 6° notch	458949-1	95360
6R1, 6R2	Resistor, fixed, composition, 3900 ohm ±10%, ½ w.	735730-69	502239
6R3, 6R4	Resistor, fixed, composition, 4700 ohm ±10%, ½ w.	735730-70	502247
6R5, 6R6	Resistor, variable, composition, 5000 ohm ±10%, 2 w.	737829-30	94039
6R7, 6R8	Resistor, fixed, composition, 5600 ohm ±10%, ½ w.	735730-71	502256
6R9, 6R10	Resistor, fixed, composition, 4700 ohm ±10%, ½ w. Same as 6R3	735730-70	502247
6R11	Resistor, variable, composition, 10,000 ohm ±10%, 2 w.	737801-43	205064
6R12	Resistor, fixed, composition, 1500 ohm ±10%, ½ w.	735730-64	502215

Approved For Release 2001/03/04 : CIA-RDP79T01049A002600030004-6

Symbol No.	Description	Drawing No.	Stock No.
6R13	Resistor, fixed, composition, 1000 ohm ±10%, ½ w.	735730-62	502210
6R14	Resistor, fixed, composition, 1 meg ±5%, ½ w.	735730-231	502510
6R15	Resistor, fixed, composition, 270,000 ohm ±10%, ½ w.	735730-91	502427
6R16 to 6R19	Resistor, fixed, composition, 1 meg ±5%, ½ w. Same as 6R14	735730-231	502510
6R20, 6R21	Resistor, fixed, composition, 56,000 ohm ±10%, 2 w.	99126-83	522356
6R22	Resistor, fixed, composition, 1000 ohm ±5%, 1 w.	90496-159	512210
6R23	Resistor, fixed, composition, 1500 ohm ±10%, ½ w. Same as 6R12	735730-64	502215
6R24	Resistor, fixed, composition, 33,000 ohm ±10%, ½ w.	735730-80	502333
6R25	Resistor, fixed, composition, 390,000 ohm ±10%, 1 w.	90496-93	512439
6R26	Resistor, fixed, composition, 2.7 meg ±10%, ½ w.	735730-103	72788
6R27	Resistor, fixed, composition, 1000 ohm ±5%, 1 w. Same as 6R22	90496-159	512210
6R28, 6R29	Resistor, fixed, composition, 56,000 ohm ±10%, 2 w. Same as 6R20	99126-83	522356
6R30	Resistor, fixed, composition, 4700 ohm ±10%, ½ w. Same as 6R3	735730-70	502247
6R31	Resistor, fixed, composition, 270 ohm ±10%, ½ w.	735730-55	502127
6R32	Not used.		
6R33	Resistor, fixed, composition, 39,000 ohm ±10%, 1 w.	90496-81	512339
6R34	Resistor, fixed, composition, 180 ohm ±10%, ½ w.	735730-53	502118
6R35	Resistor, fixed, composition, 12,000 ohm ±5%, 2 w.	99126-185	522312
6R36	Resistor, fixed, composition, 22,000 ohm ±5%, ½ w.	735730-191	502322
6R37	Resistor, variable, composition, 500,000 ohm ±10%, 2 w.	737854-5	95368
6R38	Not used.		
6R39, 6R40	Resistor, fixed, composition, 100,000 ohm ±5%, ½ w.	735730-207	502410
6R41	Resistor, variable, composition, 2.5 meg., ±10%, 2 w.	737885-12	97031
6R42, 6R43	Resistor, fixed, composition, 1.2 meg., ±5%, ½ w.	735730-233	502512
6R44	Resistor, variable, composition, 200,000 ohm ±10%, 2 w.	737854-6	95369
6R45	Resistor, fixed, composition, 22,000 ohm ±10%, ½ w.	735730-78	502322
6R46	Resistor, fixed, composition, 47,000 ohm ±10%, ½ w.	735730-82	502347
6R47	Resistor, fixed, composition, 220 ohm ±10%, ½ w.	735730-54	502122
6R48	Resistor, fixed, composition, 150,000 ohm ±10%, ½ w.	735730-88	502415
6R49	Resistor, variable, composition, 500,000 ohm ±10%, 2 w.	737854-5	95368
6R50	Resistor, fixed, composition, 39,000 ohm ±10%, 1 w. Same as 6R33	90496-81	512339
6R51	Not used.		
6R52	Not used.		
6R53	Resistor, adj. wire wound, 10,000 ohms ±10%, 25 w.	449695-6	202931
6R54	Resistor, fixed, composition, 4700 ohm ±10%, ½ w. Same as 6R3	735730-70	502247
6R55	Resistor, fixed, composition, 5600 ohm ±10%, ½ w. Same as 6R7	735730-71	502256
6R56	Resistor, fixed, composition, 4700 ohm ±10%, ½ w. Same as 6R3	735730-70	502247
6R57	Resistor, fixed, composition, 5600 ohm ±10%, ½ w. Same as 6R7	735730-71	502256
6R58	Resistor, fixed, composition, 150 ohm ±10%, ½ w.	735730-52	502115

Approved For Release 2001/03/04 : CIA-RDP79T01049A002600030004-6

Symbol No.	Description	Drawing No.	Stock No.
6R59	Resistor, fixed, composition, 470 ohm ±10%, ½ w.	735730-58	502147
6R60	Resistor, fixed, composition, 1000 ohm ±10%, ½ w. Same as 6R13	735730-62	502210
6R61	Resistor, fixed, composition, 1000 ohm ±10%, ½ w. Same as 6R13	735730-62	502210
6R62	Resistor, fixed, composition, 1500 ohm ±10%, ½ w. Same as 6R12	735730-64	502215
6R63	Resistor, fixed, composition, 10,000 ohm ±10%, ½ w.	735730-74	502310
6S1	Switch, push leaf type, non-locking, 3 break, 1 make contacts with black bakelite button	458953-3	95370
6S2	Switch, push leaf type, non-locking, break-make contact, with black bakelite button	458953-1	95386
6S3	Switch, snap action, bakelite case, s.p.d.t. contacts (Part of 6M1)	8810605-1	97447
6T1	Transformer, bell ringing	458947-1	95371
6T2	Transformer, filament	949385-1	94196
6X1 to 6X4	Socket, tube, 9 pin miniature	984055-2	94880
6X5	Socket, tube, 7 pin miniature	737867-18	94879
	Miscellaneous		
	Knob, round bakelite (for 6R11)	712336-507	30075
	Lubricant, ⅛ oz. vial of molycote, type Z	891997-33	208040
	Screw, thumb, brass, back cover holding	8886111-2	94391
	Shield, tube, 7 pin miniature type	99369-2	54521
	Shield, tube, 9 pin miniature type	8858642-3	56359

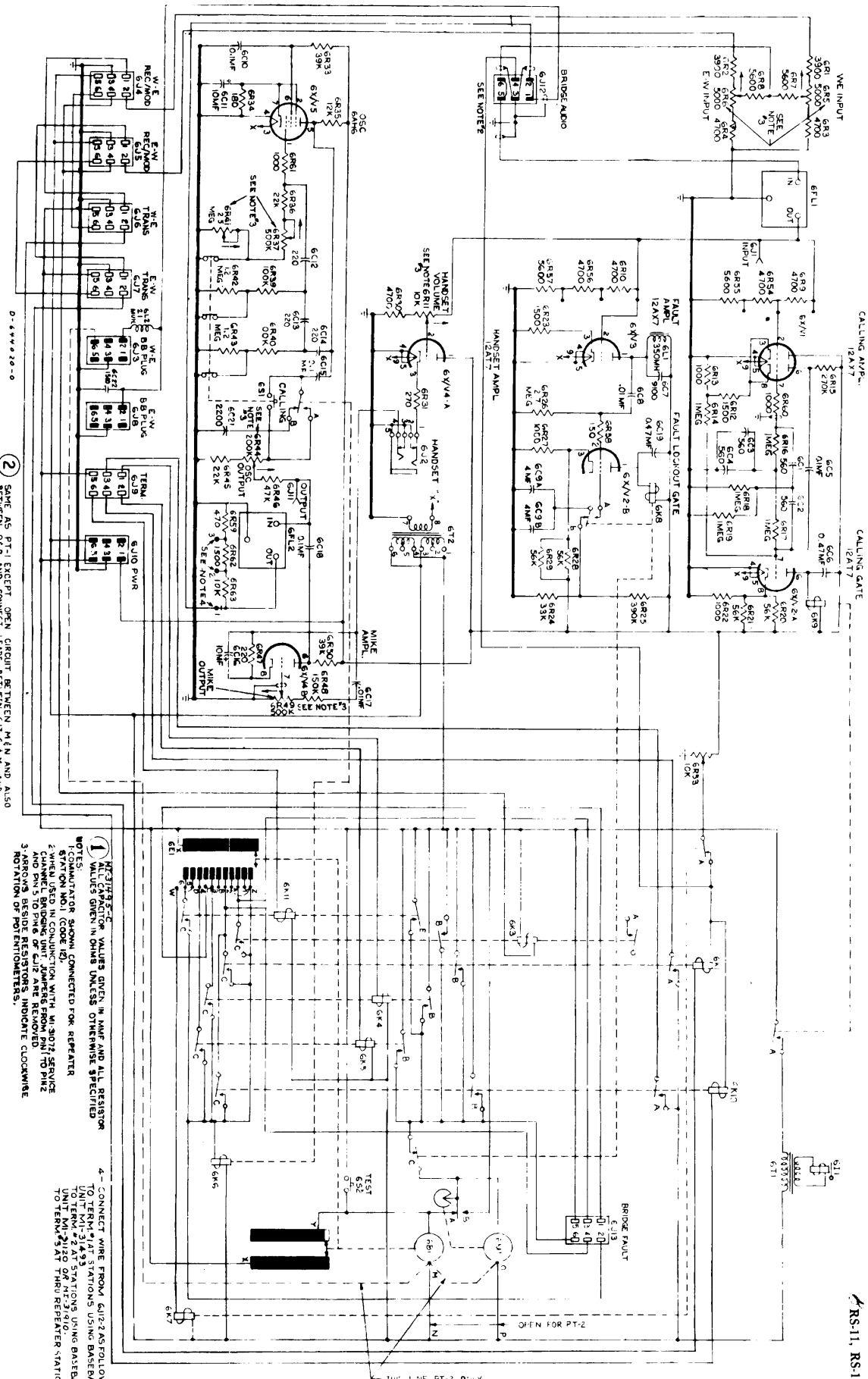


Figure RS-4—Repeater Service Unit—Schematic Diagram

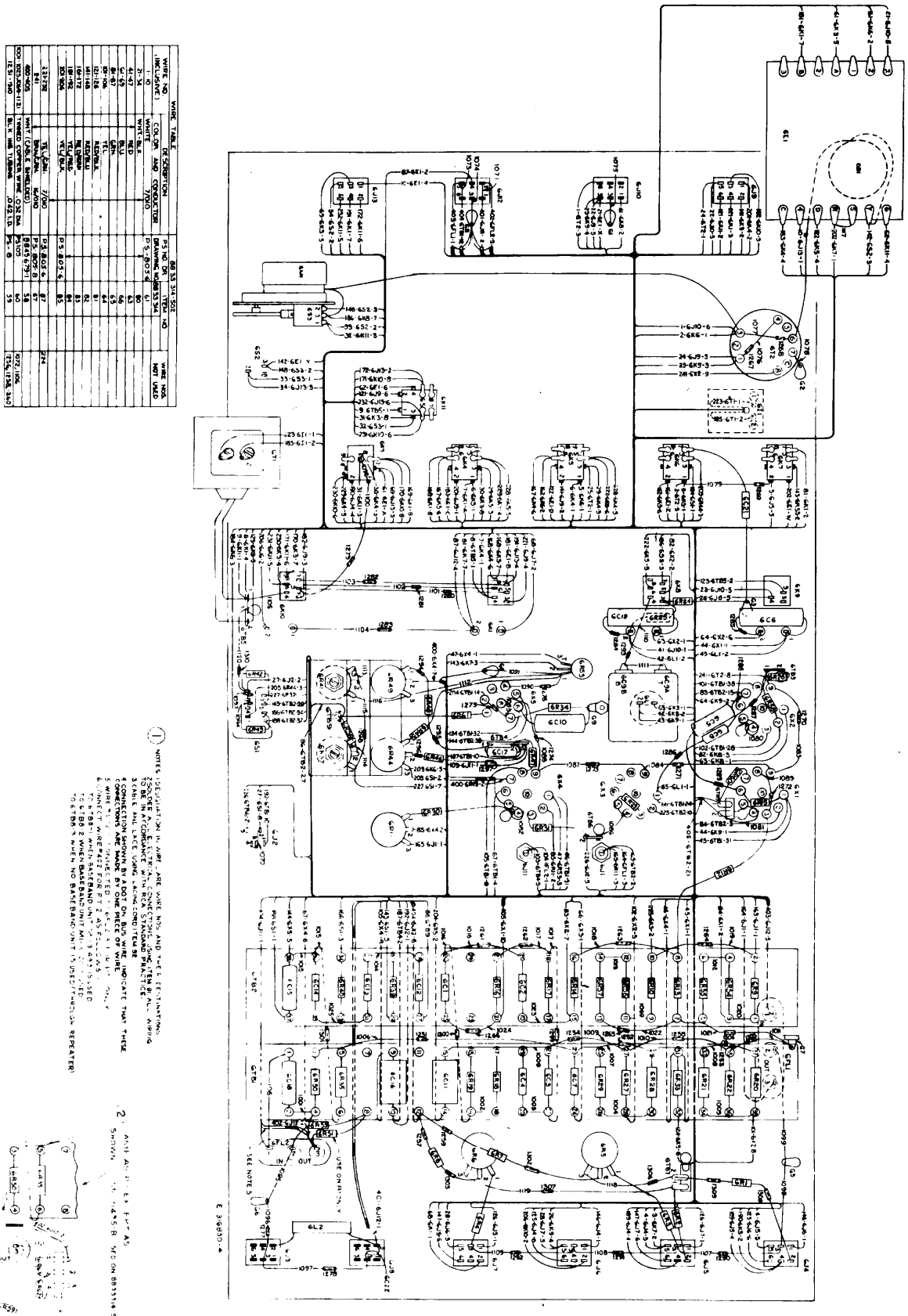


Figure RS-5—Repeater Service Unit—Wiring Diagram

C

MICROWAVE COMMUNICATION EQUIPMENT

Terminal Service Unit MI-31496 and MI-31496-A

- TECHNICAL DATA
- DESCRIPTION
- MAINTENANCE
- REPLACEMENT PARTS

RADIO CORPORATION OF AMERICA
COMMERCIAL ELECTRONIC PRODUCTS, CAMDEN, N. J.

Printed in U.S.A.
DU 566 – 567

IB-33232-2

NOTICE

This Instruction Book, IB-33232-2, contains instructions for Terminal Service Unit MI-31496 and MI-31496-A. Although the material is presented in terms of MI-31496 the information contained in this book pertains to both MI-31496 and MI-31496-A except where noted.

Approved For Release 2001/03/04 : CIA-RDP79T01049A002600030004-6

TECHNICAL DATA

Power Input:

a. Filament Heaters: 14 watts at 115 v, 50/60 cycles ac
b. Plate Supply: 70 milliamps at 250 v dc

Levels:

a. Transmitting Amp.:
Input: Telephone handset
Output: 6 v (approx.) rms across 60,000 ohms

b. Receiving Amp.:
Input: 5 v (approx.) rms across 10,000 ohms
Output: Handset

Ringing Frequency:
285 cycles

Fault Signal Frequency:
2800 cycles

Tube Complement:

Symbol	*Type*	*Function*
7V1	12AX7	Calling Amplifier
7V2	12AT7	Calling Gate and Fault Gate
7V3	12AX7	Fault Amplifier
7V4	12AT7	Handset Amplifier and Mike Amplifier
7V5	6AH6	Ring/Tone Oscillator
7V6	OB2	Voltage Regulator

Weight and Dimensions:

Weight: 16 lbs.
Height: 8¾"
Depth back of panel: 4½"
Depth front of panel: 4"
Width: Standard 19" Rack Mounting

DESCRIPTION

The Terminal Service Unit MI-31496 is designed for mounting in either a standard 19" open rack or cabinet and is installed in any station where station fault identification is required. It contains the facilities for indicating the fault signals transmitted from the repeater stations. A lamp panel indicates which station is sending the fault signals and the nature of the trouble. It is possible to identify up to five faults from any one repeater station. It also indicates the failure of the terminal transmitter or receiver. The unit also contains the voice channel equipment for party line ringing and conversation with the repeater stations.

Service channel signals (fault tone, ring tone and voice signals—300 cycle to 3kc) from the repeater service units located at the unattended repeater stations are transmitted along with the multiplex signals and when received at the terminal are separated from the multiplex signals and channelled to the terminal service unit. These service channel signals are first passed through filter 7FL1 which serves to eliminate any frequency higher than 3000 cycles which may be present due to multiplex transmission along the system. The signal voltage input to filter 7FL1 is adjusted by means of INPUT CONTROL 7R1. The signals from 7FL1 feed through separate audio amplifier circuits. One circuit, consisting of calling amplifier 7V1 and calling gate 7V2A, is a selective amplifier and gate tube tuned to 285 cycles, the ring tone signal frequency. Its selective circuit consists of a parallel "T" bandstop filter as a feed back element for the second section of the 12AX7 twin triode (7V1). The presence of a 285 cycle ring tone pulse in the input of this calling circuit energizes relay 7K1 in the plate circuit of calling gate 7V2A which operates buzzer 7I13 thereby attracting the attention of the operator or maintenance man. This alerts the terminal station personnel that a party line call is being made from another station. The party line voice signals of the service channel from filter 7FL1 are amplified by the cathode follower circuit of 7V4A before passing to the receiver of the telephone handset MI-31019-A plugged into jack 7J2. Handset volume control 7R21 sets the level of voice signals to the handset.

The presence of fault tone signals at 2800 cycles in the output of 7FL1 will activate the circuit consisting of fault amplifier 7V3 and fault gate comprised of gate tube 7V2B and relay 7K2. A 2800 cycle fault tone pulse will cause a large voltage to be developed in the plate circuit of amplifier 7V3 by the high impedance of the parallel circuit composed of reactor 7L1 and capacitor 7C7 resonant at 2800 cycles. This voltage applied to the grid of 7V2B, which is normally biased at cutoff, will cause plate current to flow and energize relay 7K2. Thus on the arrival of a fault tone signal from one of the repeater stations, relay 7K2 will close its contacts 7K2A, 7K2B and 7K2C which cause the following action to ensue: Relay contact 7K2B will energize relay 7K3 and close contact 7K3A which operates buzzer 7I13 to attract the attention of the operator.

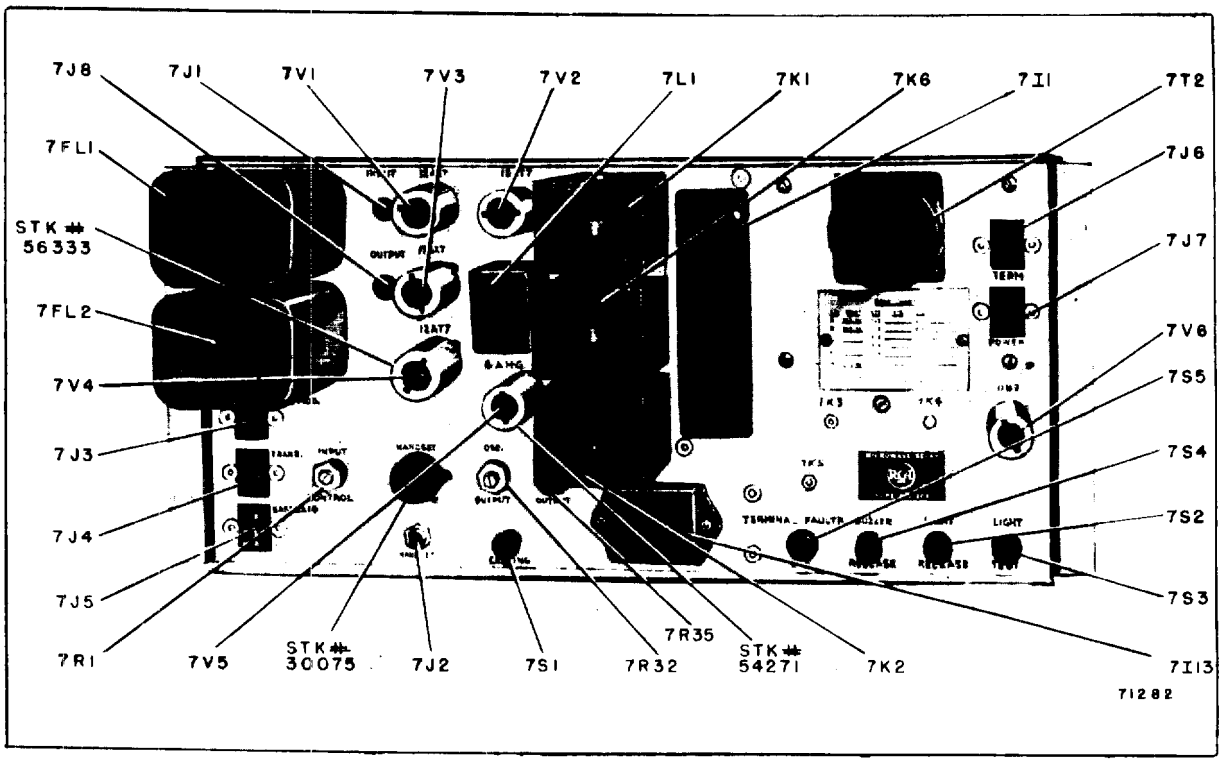


Figure TS-1—Terminal Service Unit, MI-31496—Front View

Contact 7K3B holds relay 7K3 energized after the initial impulse stops and contact 7K2B opens. This causes 7I13 to continue buzzing until the operator presses buzzer release 7S4. Pressing 7S4 will turn off buzzer 7I13 by breaking the energizing circuit of relay 7K3 after it is initially energized by a repeater station fault. Meanwhile contact 7K2C will start commutator motor 7B1 which will be maintained in operation through a full cycle by commutator segment Y. Rotation of the commutator brush arm will first cause ac voltage to be momentarily applied to relay 7K4 through commutator segment Z. This will open a contact to wipe off any previous fault indications that are showing on the neon lamps connected to the remaining commutator segments, by momentarily removing the sustaining voltage from all the lamps. As the commutator brush arm is rotated by motor 7B1 in synchronization with the transmitting commutator brush arm of a repeater service unit, the brushes will connect relay contact 7K2A successively to segments 1,A,2,B,3 etc. If a tone pulse is being received at the time period assigned to any of these particular segments, contact 7K2A will be closed and a relatively high d-c voltage will be applied to the neon lamp connected to that particular segment. After the commutator brush lights a given lamp and moves off the associated segment, the neon lamp will remain lit because of a d-c voltage applied through the resistor connected to it. This d-c voltage is held to a sufficiently low value so that the neon lamps will not light unless they have first received a high voltage pulse through the commutator segments.

By the above means, lamp (1) through (6) and "A" through "D" of the lamp indicator panel, will receive and hold an indication of the particular station at which trouble has occurred and also indicate the nature of the trouble. These lamps will remain lit until they are reset manually by the operation of light release button 7S2, or automatically when another transmission is initiated from the same or a different repeater station.

There are five numbered neon lights for the purpose of station identification to show which of the repeater stations is sending out fault transmissions. A station code will consist of either two or three tone transmissions out of the five that are possible. Using either a 2 or 3 tone group it is possible to transmit 10 separate codes and using a combination of 2 and 3 tone groups it is possible to transmit 20 separate codes.

Thus for a 10 station code any two lamp combination of the numbered lamps will indicate the re-

peater station sending the fault. For a 15 station code any 2 or 3 lamp combination of the numbered lamps will indicate the repeater station at fault. Lamps A, B, C, D and 6 are used to indicate the particular type of trouble occurring at the repeater station. Lamp A is used to indicate receiver failure; B, transmitter failure, and C, D and 6 any other indications desired by the user. It is possible for several fault transmissions to be indicated successively during any one four minute period. Two fault indications cannot occur simultaneously because the lockout circuit of relay 6K8 at each repeater station prevents a second repeater station from sending a fault transmission for a 30 second period while the initial fault transmission is occurring. The indicator panel will be lit for at least 30 seconds for each fault transmission unless cleared before that time by pressing the LIGHT RELEASE button 7S2. Upon the reception of a new fault transmission the indicator panel is cleared by the action of relay 7K4 before the new fault transmission is indicated.

When a local receiver fails, the receiver fault relay closes the 115 v ac circuit to energize relay 7K5 in the terminal service unit. Contact 7K5B energizes relay 7K3 which causes buzzer 7I13 to sound and call attention to lamp (R) (7I12) of the lamp panel which is lit by the closing of contact 7K5A to indicate that the terminal receiver is inoperative or not receiving a signal. Relay 7K6 is energized when the 1M2 monitor meter of a local transmitter drops to a predetermined value due to a greatly reduced transmitter output. This causes the contacts of 1M2 to close the energizing circuit to relay 7K6 of the terminal service unit. 7K6B sounds the calling buzzer 7I13 by energizing relay 7K3 and lights lamp (T) (7I11) on the lamp panel, indicating that a local transmitter is not working properly.

Contact C of relays 7K5 and 7K6 are not required in the equipment described in this book. At standby stations, contact C of 7K6 initiates switchover to standby operation when relay 7K6 is operated.

Test light button 7S3 is pressed to check the operation of the indicating panel lamps and its associated mechanism. When 7S3 is pressed circuits are closed to cause lamps (T) and (R) to light and motor 7B1 to go through its cycle of operation and apply firing voltage to each of the lamps on the lamp indicator panel in sequence as long as 7S3 is held in. Thus any bad lamp or bad commutation segment contact will be revealed.

Terminal Faults switch 7S5 is normally closed so that local receiver and transmitter faults will energize relays 7K5 and 7K6. After the fault has been noted 7S5 can be opened so that the light and buzzer may be turned off while working to correct the fault. This will also allow relay 1M2 to be

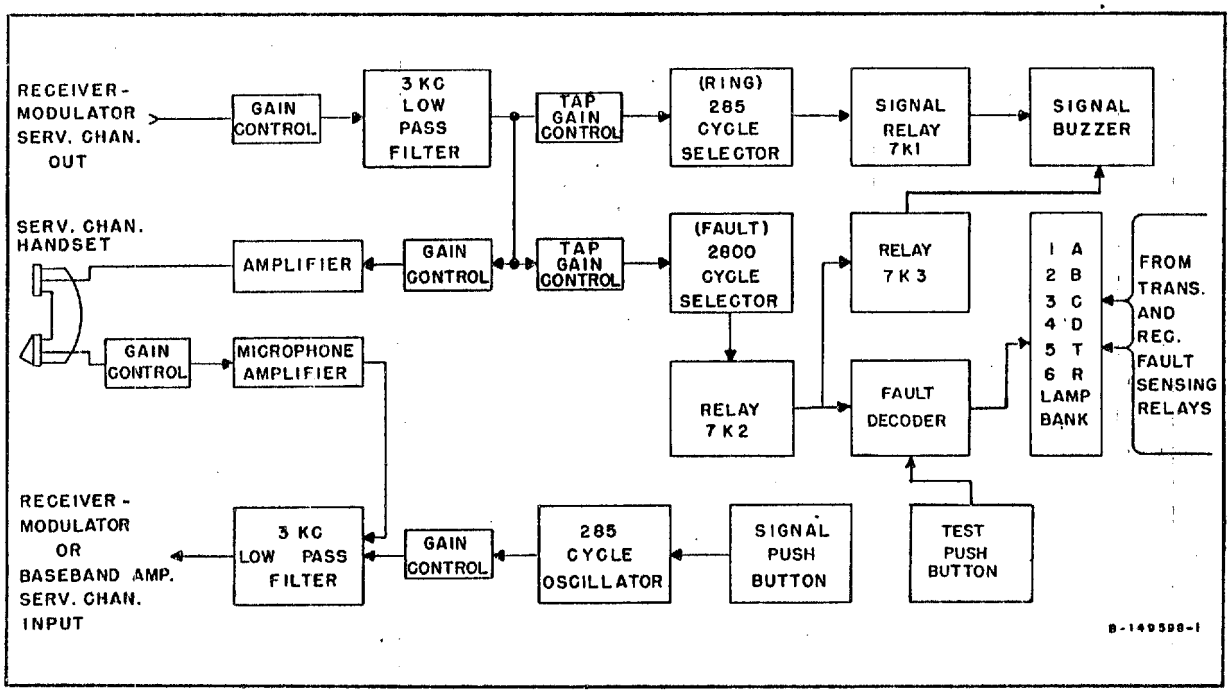


Figure TS-2—Terminal Service Unit—Block Diagram

unlocked so that the needle will be free to rise when the transmitter is again operating. A single push of buzzer release 7S4 with switch 7S5 closed will not keep 7K3 released because local faults energizing 7K5 or 7K6 are continuing voltages and not coded pulses. With 7S5 closed BUZZER RELEASE 7S4 must be held as long as the local fault lasts to keep the buzzer silenced. After a local fault has caused an indicator lamp to be lit and the buzzer to sound, opening TERMINAL FAULT switch 7S5 will permit the light to be extinguished and allow the buzzer to be silenced when the LIGHT RELEASE button and the BUZZER RELEASE button are pressed. Control 7R56 is set at 113 volts when 1M2 and 7K6 are operated.

In the transmitting portion of the unit, the 285 cycle ring tone signal for calling the repeater stations is produced in audio oscillator 7V5 and is transmitted whenever calling button 7S1 is pressed. The voice frequencies from the service channel telephone handset are amplified in 7V4B. Both the voice and ring tone signals are passed through filter 7FL2 before delivery to the baseband unit. The amplitude of ring tone and voice signals are regulated by oscillator output control 7R32 and microphone output control 7R35 respectively. Filter 7FL2 is a low-pass filter which prevents transmission of any signals having frequencies higher than 3000 cycles which would interfere with the multiplex carrier channels.

CONTROLS

a. The INPUT CONTROL (7R1) varies the amplitude of the service signal input to the 3000 cycle low-pass filter 7FL1.

b. The INPUT pinjack (7J1) is for connecting test leads to a Ballantine Model 300 voltmeter to measure the audio signal voltage output of filter 7FL1.

c. The OUTPUT pinjack (7J8) is for connecting test leads to a Ballantine Model 300 voltmeter to measure the audio signal voltage output of the ring tone oscillator 7V5 and microphone amplifier 7V4B.

d. The HANDSET VOLUME control (7R21) varies the amount of voice signal voltage applied to the grid of handset amplifier 7V4A.

e. The HANDSET jack (7J2) is for connecting the service channel telephone handset.

f. The OSCILLATOR OUTPUT screwdriver control (7R32) adjusts the level of the ring tone oscillator output fed to low-pass filter 7FL2.

g. The MIKE OUTPUT screwdriver control (7R35) adjusts the gain of microphone amplifier 7V4B.

h. The CALLING pushbutton (7S1) when pressed connects the output of the ring tone oscillator (285 cycles) to the service channel output of the unit. This signal energizes the buzzers at all other stations.

i. The TERMINAL FAULTS switch (7S5) breaks the energizing circuit of both relays 7K5 and 7K6 to allow the (T) and/or (R) fault lamps to be turned off by pressing the LIGHT RELEASE button and to allow the alarm buzzer to be quieted by pressing the BUZZER RELEASE button.

j. The BUZZER RELEASE (7S4) when pressed opens the 7K3 relay circuit breaking the 115 v ac circuit to the buzzer causing it to stop operating.

k. The LIGHT RELEASE (7S2) when pressed closes the circuit of relay 7K4 which opens a contact that wipes off any previous lamp indications showing on the lamp indicator panel.

l. The LIGHT TEST pushbutton (7S3) when pressed runs the fault commutator motor through its cycle causing the indicator lamps to light in sequence and reveal any neon bulb not operating. 7S3 must be held in for the duration of the test.

m. The RING TONE OSCILLATOR frequency control 7R29 is a screwdriver adjustable potentiometer, reached from the rear of the unit, for setting the frequency of the oscillator 7V5 to the ring tone frequency of 285 cycles.

MAINTENANCE

General Notes

Fault Indicating Section

a. A test of the condition of the neon bulbs of the lamp indicating panel and the operation of the commutator assembly should be made daily. Press LIGHT TEST switch, 7S3, and hold depressed. Ensure that the lamps come on in the following order: 1, A, 2, B, 3, C, 4, D, 5, 6. The lamps R and T should come on immediately when 7S3 is depressed. Continue to hold 7S3 depressed and when the commutator starts on its second revolution ensure that relay 7K4 extinguishes all the lamps, and that they relight in the above order. Release 7S3 when the lamp, "6" comes on, and the commutator brush arm will come to rest in its stop position. Press LIGHT RELEASE switch, 7S2, and ensure that all lamps are extinguished.

b. Before replacing a lamp that fails to light it should first be determined if the commutator is at fault. A bad commutator brush contact or dirty

segment may cause a bulb not to light or it may cause loss of synchronism between the repeater and terminal commutator brush arms which will give a false indication. If faulty brush contact causes trouble, this can be corrected by performing the following adjustment:

Loosen the screw holding the brush arm and rotate it in the direction that will increase the pressure of the brushes against the commutator plate and then tighten the arm in this position. Be sure that the pressure of the brushes against the segments is sufficient to make positive contact.

c. Check the action of the receiver fault relay 7K5 by removing 2V1 the first i-f tube of the receiver/modulator. (Be certain that the TERMINAL FAULTS switch 7S5 is in the ON position.) This will energize relay 7K5, which, if operating normally, will cause the buzzer to sound and light indicator lamp R. After replacing 2V1, press the LIGHT RELEASE switch 7S2 to check the operation of light release relay 7K4. Lamp R should be extinguished. Also press the BUZZER RELEASE switch 7S4 to silence the buzzer.

Input Circuit

a. See that the INPUT CONTROL 7R1 is turned to the maximum clockwise position.

b. If the calling buzzer has a tendency to sound when voice signals are being received, the input voltage to calling amplifier 7V1 must be reduced by moving the grid input connection to the next lower tap of the 7R3, 7R58, 7R59 resistance network.

c. The normal connection to the control grid of fault amplifier 7V3 is at the junction of 7R15 of the resistance network and 7J1 as shown on the terminal service unit schematic. If voice signals cause the commutator brush arm to turn, and cause the lamps to light, the fault amplifier gain can be reduced by moving the control grid connection to a lower tap on the 7R15, 7R60, 7R61 network.

d. Adjust the HANDSET VOLUME control to the desired listening level.

e. To check the proper operation of relays 7K1 and 7K2 and the amplifier circuits associated with them, send out a calling tone and a simulated fault tone from a repeater station and observe whether or not the buzzer sounds and the commutator motor runs.

Output Circuit

a. The adjustment of the level of the service signals applied to the baseband unit from the terminal service unit is made as follows:

1. Connect an audio voltmeter (Ballantine Model 300 or equivalent) to pin 7J5-2 and ground.

2. Press the CALLING button and adjust the OSC OUTPUT control for a meter reading of:
   (a) 1.32 volts when used with Baseband Unit MI-31493.
   (b) 0.325 volts when used with Baseband Unit MI-31120.

3. Speak into the handset microphone and adjust the MIKE OUTPUT control for a meter reading of from:
   (a) 0.5 to 0.8 volts when used with Baseband Unit MI-31493.
   (b) 0.12 to 0.2 volts when used with Baseband Unit MI-31120.

b. Adjust 7R56 so that the voltage to 7K6 is 113 v with the transmitter output meter-relay (1M2) in the condition of having its red and black arms touching (contacts closed).

c. At stations where Baseband Unit MI-31493 is used, the terminal service unit output connection is to be made at the junction of 7R69 and the "OUT" terminal of 7FL2. At stations where Baseband Unit MI-31120 is used, the terminal service unit output connection is to be made at the junction of 7R69 and 7R68. The specified levels cannot be obtained if the wrong output connection is used.

TYPICAL TERMINAL SERVICE UNIT VOLTAGES

The following are typical voltages between various tube pins and ground as read with a vacuum tube voltmeter. All voltages are dc unless otherwise noted.

Tube	*Type*	*Function*	*Pin #1*	*Pin #2*	*Pin #3*	*Pin #4*	*Pin #5*	*Pin #6*	*Pin #7*	*Pin #8*	*Pin #9*
7V1	12AX7	Calling Amp. . .	250	0	2.5	0	0	140	1.0	2.5	6.3 a.c.
7V2	12AT7	Calling, Fault Gate	248	0	5.9	0	0	250	1.0	8.4	6.3 a.c.
7V3	12AX7	Fault Amp. . . .	250	0	2.0	0	0	—	—	—	6.3 a.c.
7V4	12AT7	Handset, Mike Ampl.	250	0	3.0	0	0	95	0	1	6.3 a.c.
7V5	6AH6	Osc.	–0.8	1.8	—	6.3 a.c.	150	150	1.8	—	—

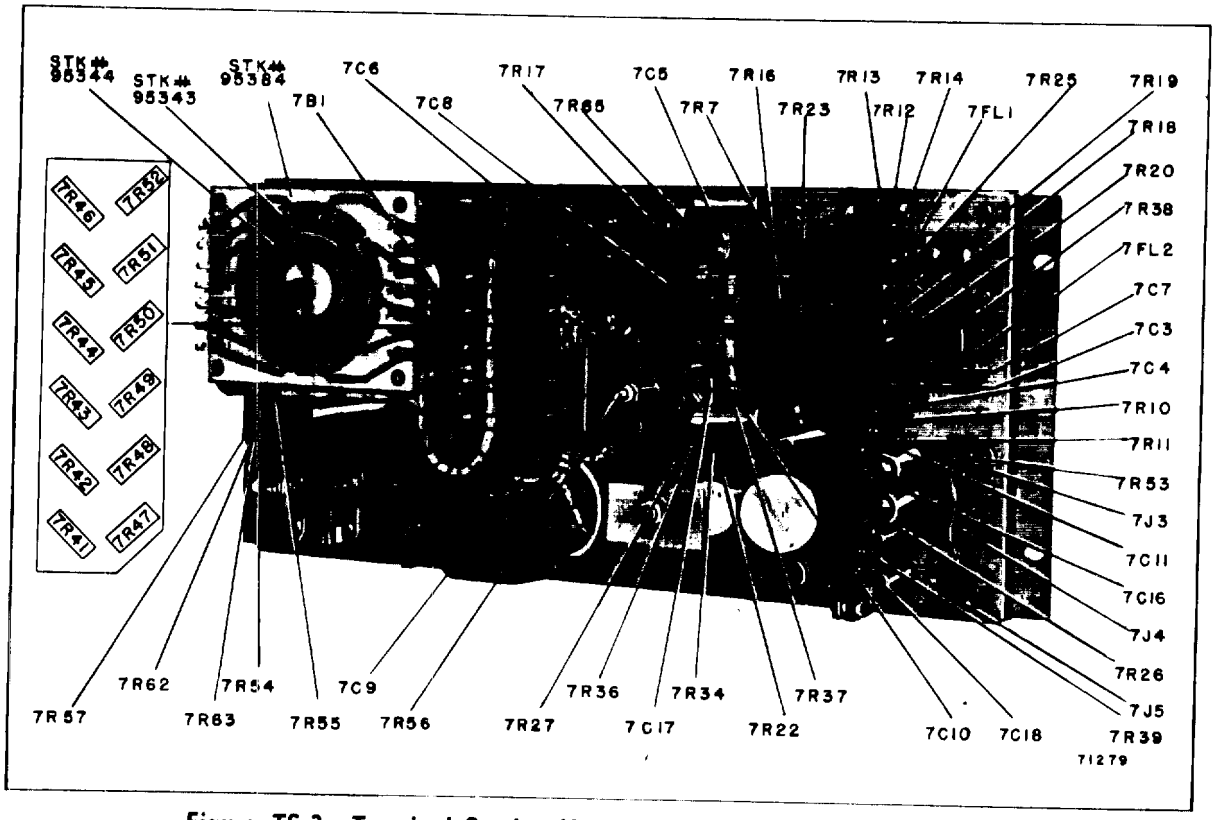


Figure TS-3—Terminal Service Unit—Rear View, Dust Cover Removed

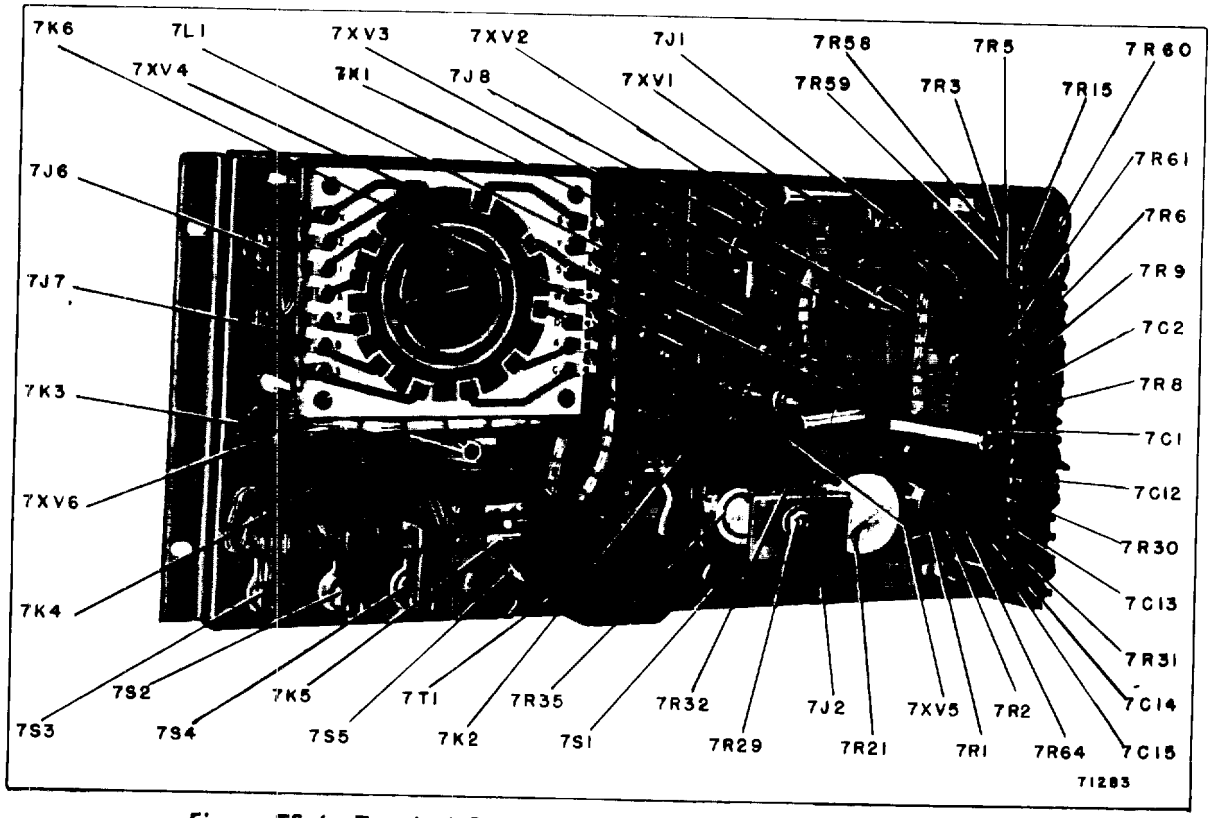


Figure TS-4—Terminal Service Unit—Rear View, Dust Cover Removed

REPLACEMENT PARTS LIST

Symbol No.	Description	Drawing No.	Stock No.
7B1	Motor, synchronous, clock type, 115 v., 60 cycle, 5 rpm, counter clockwise	8833318-1	95340
7C1 to 7C4	Capacitor, fixed, mica, 560 mmf ±2%, 500 v.	722022-553	72841
7C5	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v.	735715-175	73551
7C6	Capacitor, fixed, paper, 0.47 mf ±20%, 200 v.	735715-33	73787
7C7	Capacitor, fixed, mica, 9100 mmf ±2%, 300 v.	722029-562	95383
7C8	Capacitor, fixed, mica, 0.01 mf ±10%, 400 v.	727865-71	92036
7C9	Capacitor, fixed, paper, 0.47 mf ±20%, 200 v. Same as 7C6	735715-33	73787
7C10	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v. Same as 7C5	735715-175	73551
7C11	Capacitor, dry electrolytic, 10 mf, 25 v.	442901-46	52533
7C12 to 7C14	Capacitor, fixed, mica, 1000 mmf ±2%, 500 v.	722022-559	90003
7C15	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v. Same as 7C5	735715-175	73551
7C16	Capacitor, dry electrolytic, 10 mf, 25 v. Same as 7C11	442901-46	52533
7C17	Capacitor, fixed, paper, 0.01 mf ±10%, 400 v.	735715-163	73561
7C18	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v. Same as 7C5	735715-175	73551
7C19	Not used.		
7E1	Commutator Assembly—(following parts only stocked)	744080-501	
	Plate, terminal code signal commutator plate assembly, complete with contacts and terminals	458943-501	95384
	Clip, contact brush holding clip	128727-1	95344
	Contact, sliding, for code signal commutator assembly	128746-1	95343
7FL1	Filter, low pass, 3.6 to 100 kc/s impedance 5000 ohm	8833307-2	95345
7FL2	Filter, low pass, 3.6 to 100 kc/s impedance 10,000 ohm	8833306-2	95346
7I1 to 7I12	Lamp, neon pigtail type	872291-14	95385
7I13	Buzzer, door bell type 8-12 v., 60 cycle	8848315-3	95347
7J1	Connector, female, pin jack	742565-1	93678
7J2	Connector, female, telephone jack	8845648-1	94232
7J3, 7J4	Connector, female, 6 contact, chassis mtg.	181494-4	18534
7J5	Connector, male, 6 contact, chassis mtg.	181494-3	28507
7J6	Connector, female, 6 contact, chassis mtg. Same as 7J3	181494-4	18534
7J7	Connector, male, 6 contact, chassis mtg. Same as 7J5	181494-3	28507
7J8	Connector, female, pin jack. Same as 7J1	742565-1	93678
7K1	Relay, dc, coil 41 v., 1 form "C" break-make contact	174913-6	95352
7K2	Relay, dc, coil 68 v., 3 form "A" make contacts	174913-8	95348
7K3, 7K4	Relay, ac, midget type, coil 115 v. 50/60 cycle, dpdt contacts	458952-1	95350
7K5	Relay, ac, midget type, coil 115 v., 50/60 cycle, 3 p.s.t., normally open contacts	458952-2	95349
7K6	Relay, dc, coil 68 v., 3 form "A" make contacts. Same as 7K2	174913-8	95348
7L1	Reactor, iron core, 350 mh	8833309-1	95359
7R1	Resistor, variable, composition, 2000 ohm ±10%, 2 w.	737829-29	51925
7R2	Resistor, fixed, composition, 2200 ohm ±10%, ½ w.	735730-66	502222
7R3	Resistor, fixed, composition, 4700 ohm ±10%, ½ w.	735730-70	502247
7R4	Resistor, fixed, composition, 1500 ohm ±10%, ½ w.	735730-64	502215
7R5	Resistor, fixed, composition, 1000 ohm ±10%, ½ w.	735730-62	502210
7R6	Resistor, fixed, composition, 1 meg ±5%, ½ w.	735730-231	502510
7R7	Resistor, fixed, composition, 270,000 ohm ±10%, ½ w.	735730-91	502427
7R8 to 7R11	Resistor, fixed, composition, 1 meg ±5%, ½ w. Same as 7R6	735730-231	502510
7R12	Resistor, fixed, composition, 1000 ohm ±5%, 1 w.	90496-159	512210
7R13, 7R14	Resistor, fixed, composition, 56,000 ohm ±10%, 2 w.	99126-83	28741
7R15	Resistor, fixed, composition, 4700 ohm ±10%, ½ w. Same as 7R3	735730-70	502247

Symbol No.	Description	Drawing No.	Stock No.
7R16	Resistor, fixed, composition, 1500 ohm ±10%, ½ w. Same as 7R4	735730-64	502215
7R17	Resistor, fixed, composition, 1 meg ±5%, ½ w. Same as 7R6	735730-231	502510
7R18	Resistor, fixed, composition, 680 ohm ±5%, 1 w.	90496-155	512168
7R19, 7R20	Resistor, fixed, composition, 56,000 ohm ±10%, 2 w. Same as 7R13	99126-83	28741
7R21	Resistor, variable, composition, 10,000 ohm ±10%, 2 w.	737801-43	68833
7R22	Resistor, fixed, composition, 4700 ohm ±10%, ½ w. Same as 7R3	735730-70	502247
7R23	Resistor, fixed, composition, 270 ohm ±10%, ½ w.	735730-55	502127
7R24	Not used.		
7R25	Resistor, fixed, composition, 39,000 ohm ±10%, 1 w.	90496-81	512339
7R26	Resistor, fixed, composition, 10,000 ohm ±10%, 2 w.	99126-74	522310
7R27	Resistor, fixed, composition, 150 ohm ±10%, 1 w.	90496-52	512115
7R28	Not used.		
7R29	Resistor, variable, composition, 500,000 ohm ±10%, 2 w.	737854-5	95368
7R30, 7R31	Resistor, fixed, composition, 270,000 ohm ±10%, ½ w. Same as 7R7	735730-91	502427
7R32	Resistor, variable, composition, 200,000 ohm ±10%, 2 w.	737854-6	95369
7R33	Resistor, fixed, composition, 22,000 ohm ±10%, ½ w.	735730-78	502322
7R34	Resistor, fixed, composition, 47,000 ohm ±10%, ½ w.	735730-82	502347
7R35	Resistor, variable, composition, 500,000 ohm ±10%, 2 w. Same as 7R29	737854-5	95368
7R36	Resistor, fixed, composition, 150,000 ohm ±10%, ½ w.	735730-88	502415
7R37	Resistor, fixed, composition, 220 ohm ±10%, ½ w.	735730-54	502122
7R38	Resistor, fixed, composition, 12,000 ohm ±5%, ½ w. (for MI-31496 only)	82283-185	502312
7R39	Resistor, fixed, composition, 39,000 ohm ±10%, 1 w. Same as 7R25	90496-81	512339
7R40	Not used.		
7R41 to 7R52	Resistor, fixed, composition, 82,000 ohm ±10%, ½ w.	735730-85	502382
7R53	Resistor, fixed, composition, 6800 ohm ±10%, ½ w.	735730-72	502268
7R54, 7R55	Resistor, fixed, composition, 18,000 ohm ±10%, 2 w.	99126-77	522318
7R56	Resistor, adj. wire wound, 10,000 ohm ±10%, 25 w.	449695-6	202931
7R57	Resistor, fixed, composition, 68,000 ohm ±10%, ½ w.	735730-84	502368
7R58	Resistor, fixed, composition, 4700 ohm ±10%, ½ w. Same as 7R3	735730-70	502247
7R59	Resistor, fixed, composition, 5600 ohm ±10%, ½ w.	735730-71	502256
7R60	Resistor, fixed, composition, 4700 ohm ±10%, ½ w. Same as 7R3	735730-70	502247
7R61	Resistor, fixed, composition, 5600 omh ±10%, ½ w. Same as 7R59	735730-71	502256
7R62, 7R63	Resistor, fixed, composition, 68,000 ohm ±10%, ½ w. Same as 7R57	735730-84	502368
7R64	Resistor, fixed, composition, 2200 ohm ±10%, ½ w. Same as 7R2	735730-66	502222
7R65	Resistor, fixed, composition, 150 ohm ±10%, ½ w.	82283-52	502115
7R66, 7R67	Resistor, fixed, composition, 1000 ohm ±10%, ½ w. Same as 7R5	735730-62	502210
7R68	Resistor, fixed, composition, 1800 ohm ±10%, ½ w. (for MI-31496-A only)	735730-65	502218
7R69	Resistor, fixed, composition, 10,000 ohm ±10%, ½ w. (for MI-31496-A only)	735730-74	502310
7S1, 7S2	Switch, push, leaf type, form "C" break-make contacts	458953-1	95386
7S3	Switch, push, leaf type, 4 make contacts	458953-2	95387
7S4	Switch, push, leaf type, form "C" break-make contacts. Same as 7S1	458953-1	95386
7S5	Switch, lever, telephone type, one way locking dpst normally closed	8833320-1	95388
7T1	Transformer, bell ringing	458947-1	95371
7T2	Transformer, filament	949385-1	94196
7XV1 to 7XV4	Socket, tube, 9 pin miniature	984055-2	56333
7XV5, 7XV6	Socket, tube, 7 pin miniature	99370-2	94879
	Knob, round black bakelite, for 7R21	712336-507	30075
	Screw, thumb, brass, back cover holding	8886111-2	94391
	Shield, tube, 7 pin, miniature, 1¾" lg.	99369-2	54521
	Shield, tube, 7 pin, miniature, 2¼" lg.	99369-3	57540
	Shield, tube, 9 pin, miniature, 1 15/16" lg.	8858642-3	56359

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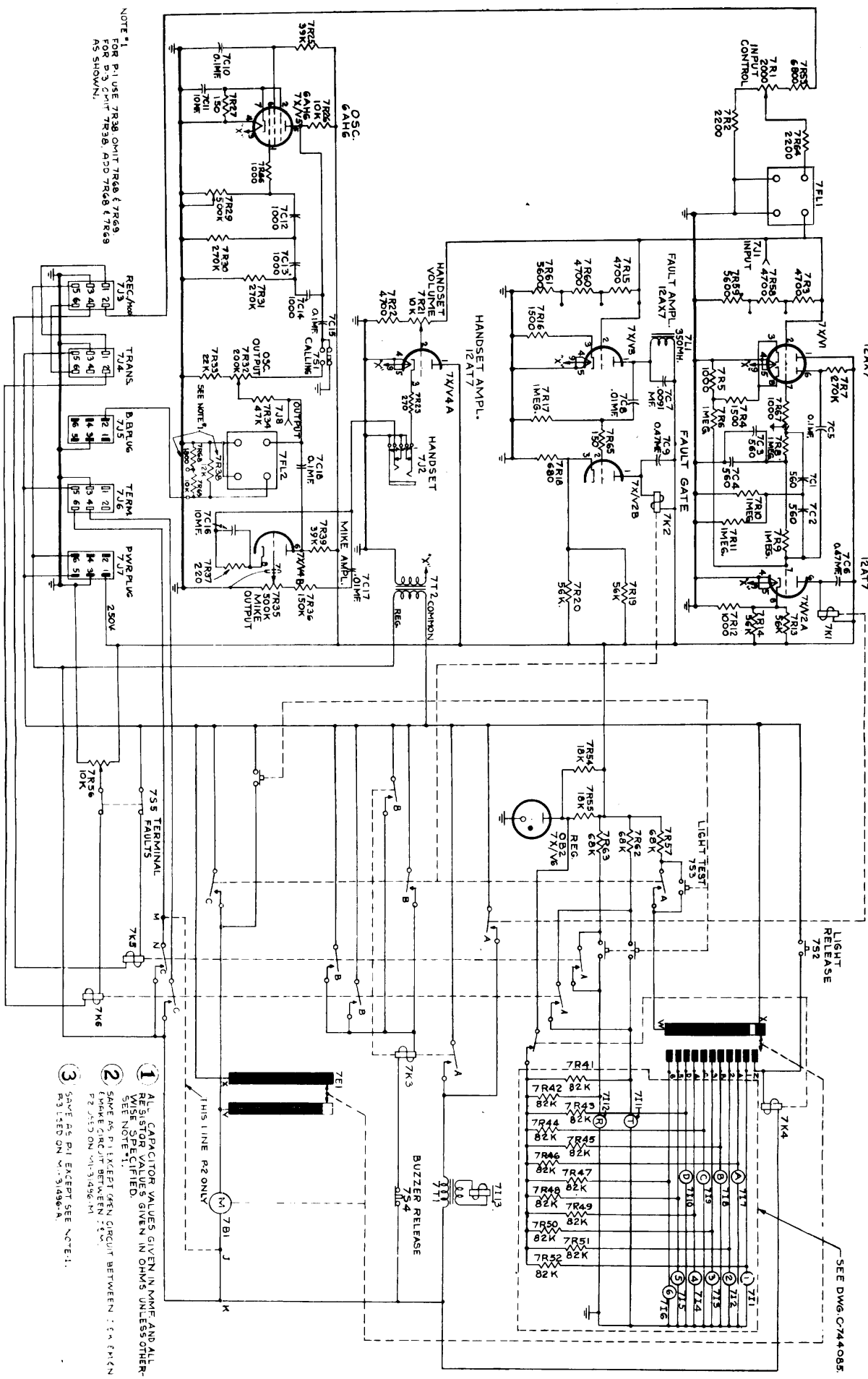
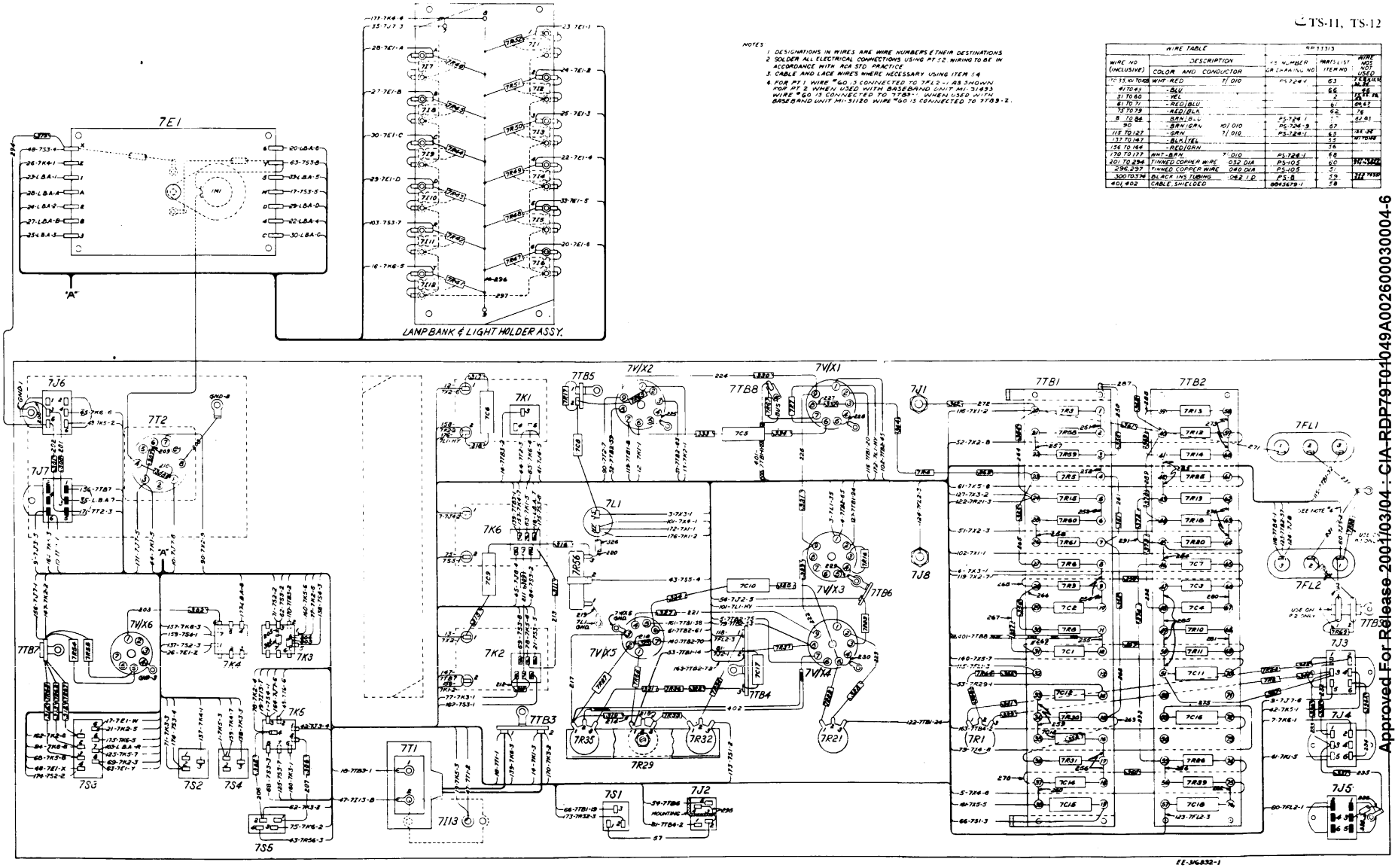


Figure TS-5—Terminal Service Unit, MI-31496—Schematic Diagram

TS-9, TS-10



NOTES:
1. DESIGNATIONS IN WIRES ARE WIRE NUMBERS & THEIR DESTINATIONS
2. SOLDER ALL ELECTRICAL CONNECTIONS USING PT 52 WIRING TO BE IN ACCORDANCE WITH RCA STD. PRACTICE
3. CABLE AND LACE WIRES WHERE NECESSARY USING ITEM 14
4. FOR PT 1 WIRE "GO 3 CONNECTED TO 7FL2-1 AS SHOWN FOR PT 2 WHEN USED WITH BASEBAND UNIT MI-31493 WIRE "GO 13 CONNECTED TO 7TB9-1 WHEN USED WITH BASEBAND UNIT MI-31120 WIRE "GO 13 CONNECTED TO 7TB9-2.

WIRE TABLE				GM 13313	
WIRE NO (INCLUSIVE)	DESCRIPTION COLOR AND CONDUCTOR		CS NUMBER OR DRAWING NO	PARTS LIST ITEM NO	WIRE NOT USED
TO 13, 40 TO 100	WHT-RED	7/.010	PS-7247	63	
41 TO 45	-BLU			66	
31 TO 40	-YEL			2	
61 TO 71	-RED/BLU			61	
75 TO 79	-RED/BLK			62	
8 TO 86	-BRN/BLU		PS-724 1	1	
90	-BRN/GRN	10/.010	PS-724-3	67	
115 TO 127	-GRN	7/.010	PS-724-1	65	
137 TO 147	-BLK/YEL			55	
156 TO 164	-RED/GRN			76	
170 TO 177	WHT-BRN	7/.010	PS-724-1	68	
201 TO 294	TINNED COPPER WIRE	.032 DIA	PS-105	60	
296,297	TINNED COPPER WIRE	.040 DIA	PS-105	5	
300 TO 374	BLACK INS TUBING	.062 I.D	PS-8	79	
401, 402	CABLE, SHIELDED		8043679-1	78	

EE-36832-1

(1) USE ON MI-31496

(2) SAME AS PT 1 EXCEPT AS SHOWN AT 7FL2 (7TB9 USE ON MI-31496 A

Figure TS-6—Terminal Service Unit, MI-31496—Connection Diagram

MICROWAVE COMMUNICATION EQUIPMENT

T.O. 31R5-4-A-21

Power Supply MI-31494-B

- TECHNICAL DATA
- DESCRIPTION
- MAINTENANCE
- REPLACEMENT PARTS

RADIO CORPORATION OF AMERICA
COMMUNICATION PRODUCTS DEPARTMENT, CAMDEN, NEW JERSEY

PRINTED IN U.S.A.
DU 539

IB-33230-2

Approved For Release 2001/03/04 : CIA-RDP79T01049A002600030004-6

TECHNICAL DATA

Power Input:

95 to 125 volts rms 50/60 cycles, 1000 watts

Power Outputs:

500 volts dc at full load of 600 ma
ripple: 1.0 volts rms max.

250 volts dc at full load of 500 ma
ripple: 0.030 volts rms max.

115 v ac 50/60 cycles 300 w Local Supply Voltage

115 v ac 50/60 cycles ±5%, 250 w, controlled by auto-transformer taps.

Weight and Dimensions:

Weight: 275 lbs. packed
225 lbs. net

Height: 14"

Depth Back of Panel: 12"

Depth Front of Panel: 5"

Width: Standard 19" Rack Mounting

Tube Complement

Symbol	*Type*	*Function*
5V1	3B28	H.V. Rectifier
5V2	3B28	H.V. Rectifier
5V3	3B28	L.V. Rectifier
5V4	3B28	L.V. Rectifier

Fuses:

Symbol	*Rating*	*Circuit*
5F6	*	ac common
5F7	*	ac for 250 v supply
5F8	*	ac for 500 v supply
5F9	.2 amp.	250 v dc
5F10	*	ac regulated
5F11	.2 amp.	250 v dc.
5F12	.3 amp.	500 v dc
5F13	.8 amp.	ac regulated
5F14	.8 amp.	ac unregulated
5F15	*	250 v dc.
5F16	*	500 v dc
5F17	*	ac regulated
5F18	*	ac unregulated

* Refer to the Replacement Part List.

DESCRIPTION

The Power Supply MI-31494-B is built for installation in either a standard 19" open rack or cabinet and is used in both terminal and repeater stations. It operates from a 115 v ac, 50-60 cycle source and supplies 250 v and 500 v dc and 115 v ac to the other rack units.

Power Supply MI-31494-B has two separate rectifying sections each employing two 3B28 rectifier tubes in a full wave rectifier circuit. Separate high voltage transformers, 5T3 and 5T2, are provided for each rectifier section. Rectifier filament voltage is supplied by a third transformer 5T1, the primary of which is tapped to permit adjustment of the regulated ac to 115 volts for several different line voltages. These primary taps also permit adjustment of the voltage supplied to the primary of each high voltage transformer, so that each rectifier output voltage can be adjusted to near its nominal value for various values of line voltage and load current. Each section employs double choke filtering assuring a dc voltage with extremely low ripple content. The ac input circuit and all the ac and dc output circuits are protected by fuses.

Time delay relay 5K3 is provided to prevent application of plate voltage to the rectifier tubes before the filaments are emitting properly. The rectifier tubes may be damaged and the fuses blown if the filaments are not warmed up before the high voltage is applied. When line switch 5S1 is closed, relay 5K3 operates after a time delay of from 20 to 40 seconds. This allows sufficient time for the filaments to warm up before high voltage is applied to the plates.

5K3 will not release until from 2 to 3 seconds has elapsed after opening line switch 5S1. This prevents sharp drops in line voltage from releasing 5K3 which would cause 20 to 40 second periods during which the station is not operating.

The voltages available for the other rack units are 250 and 500 volts dc and 115 volts ac. Plug 5P1 provides the means for making the input connection to the primary tap of filament transformer 5T1 which best accommodates the actual ac input voltage. This will also adjust the 115 v ac at terminals 5 and 6 of jacks 5J2, 5J3 and 5J4. 5TB1 provides a means of changing the ac input to the +250 v and +500 v rectifying sections. This permits these supplies to be adjusted to deliver near their nominal output voltages for different values of output current.

If the line voltage is not subject to rapid transients, and if its variation is not greater than ±5% from nominal, this supply can be connected

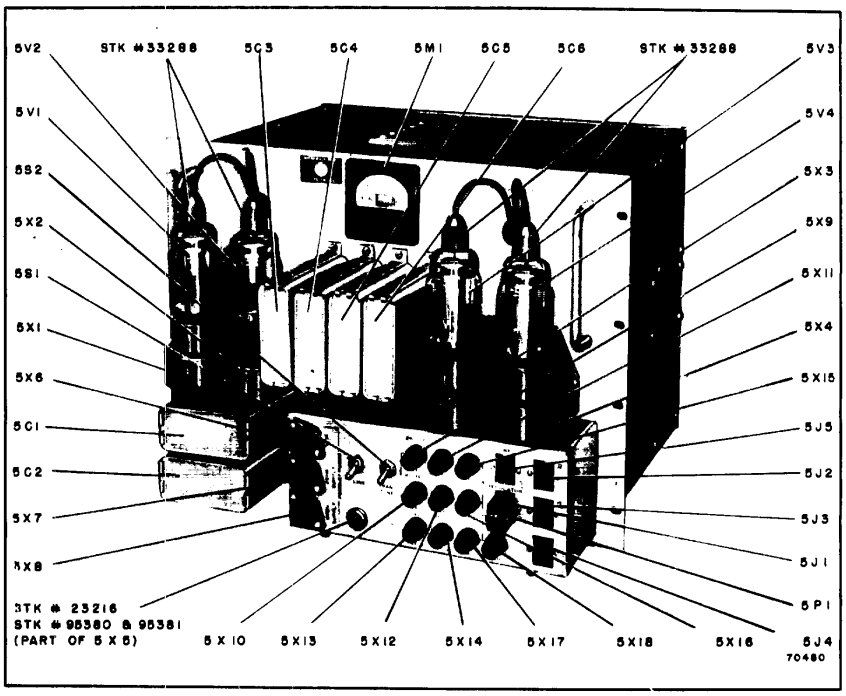


Figure PS-1—Power Supply, MI-31494-B—Front View

directly to the line. If these conditions are not adhered to, however, an ac regulating transformer should be used between the line and the power supply input.

CONTROLS

a. The LINE switch 5S1 is a double pole single throw switch which connects and disconnects all input power.

b. The TRANS TUNE switch 5S2 closes and opens the 115 v ac supply to the primary of transformer 5T3 of the 500 volt rectifier section.

c. Lamp 5I1 illuminates the red jewel on the fuse panel indicating that the power supply unit is receiving 115 v ac from its power source, and that line switch 5S1 is "ON."

d. Hour meter 5M1 registers the total time that the unit has been in operation.

MAINTENANCE

General Notes

a. Measure the voltage at terminal 5-6 of jacks 5J2, 5J3 or 5J4 periodically to see that the correct connection in plug 5P1 is being used. Also check the dc output voltages to see that the proper connections to 5TB1 are being used.

b. If an objectional 120 cycle hum develops in the equipment, check the ripple voltage in both the 500 v and 250 v dc outputs. If the ripple voltage is greater than 1 volt for the 500 v dc supply or more than 0.030 volt for the 250 v dc supply the condition of the filter capacitors 5C1 thru 5C6 should be checked and the faulty capacitor or capacitors replaced.

c. Check the rectifier filament voltages to see that they are approximately 2.5 volts.

d. The recommended fuse type for 5F6, 7 and 8 is the Bussman Fusetron Type FNM and for 5F9 thru 5F18 is either Bussman Fusetron Type MDM or LittleFuse 4AG Slo-Blo.

Typical Power Supply Voltage and Current Readings

The following are dc voltages measured between the listed points and ground. The input line voltage for these measurements is 115 v, and the jumper in 5P1 is connected from Pin 6 to Pin 1. For the full load condition the 5T2 input is connected to the 115 v tap, on terminal board 5TB1. For the minimum load condition the 5T2 input is connected to the 105 v tap on 5TB1. 5T3 input is connected through switch 5S2 to the 115 volt tap on 5TB1 under other load conditions.

D. C. Voltages

Point	*Full Load Voltage*	*Min. Load Voltage*
Pin 4, 5V1-5V2	564	564
High Side, 5C1	533	557
Pin 2, 5J4	500	550
Pin 2, 5J3	500	550
Pin 4, 5V3, 5V4	300	283
High Side, 5C3	275	270
Pin 1, 5J4	250	250 with proper 5TB1 connections
Pin 1, 5J3	250	250 with proper 5TB1 connections

The following are the rms ac voltages and currents measured between various points in the power supply. These readings were taken with the same conditions exisiting as described for the dc voltage measurements.

A.C. R.M.S. Voltages

Voltmeter Position	*Full Load Voltage*	*Min. Load Voltage*
Across primary 5T3 ...	115	115
Plate 5V1 to ground ...	645	650
Plate 5V2 to ground ...	645	650
Across primary 5T2 ...	115	115
Plate 5V3 to ground ...	370	330
Plate 5V4 to ground ...	370	330
Pin 3 to Pin 5, 5J1 ...	95	95
Pin 4 to Pin 5, 5J1 ...	105	105
Pin 1 to Pin 5, 5J1 ...	115	115
Pin 2 to Pin 5, 5J1 ...	125	125
Pin 5 to Pin 6, 5J2-3-4 .	115	115
Pin 5 to Pin 4, 5J3-4 ..	115	115

A.C. R.M.S. Currents

Ammeter Position	*Full Load Current*	*Min. Load Current*
Across Fuse Holder 5X8 (5F8 removed)	3.7 amps.	1.1 amps.
Across Fuse Holder 5X7 (5F7 removed)	1.8 amps.	.92 amps.
Across Fuse Holder 5X6 (5F6 removed)	8.2 amps.	—

REPLACEMENT PARTS LIST

Symbol No.	*Description*	*Drawing No.*	*Stock No.*
5C1, 5C2	Capacitor, fixed, paper, 10 mf., ±20%, 1000 v.	984619-117	18118
5C3 to 5C6	Capacitor, fixed, paper, 10 mf., ±20%, 600 v.	984619-108	18501
5F1 to 5F5	Not used.		
5F6	Fuse, cartridge, 8 amp., 250 v. (for use at all non-standby terminal or repeater stations and junction terminal or repeater stations, not utilizing baseband bridge MI-31151)	8835339-3	95105
5F6	Fuse, cartridge, 10 amp., 250 v. (for use at all standby stations and non-standby junction stations utilizing the baseband bridge MI-31151)	8835339-6	96162
5F7	Fuse, cartridge, 2 amp., 250 v. (for terminal or repeater station only)	8835339-1	95107
5F7	Fuse, cartridge 2.5 amp., 250 v. (for terminal or repeater station with standby only)	8835339-4	96160
5F8	Fuse, cartridge, 4 amp., 250 v. (for terminal or repeater station only)	8835339-2	95106
5F8	Fuse, cartridge, 5 amp., 250 v. (for terminal or repeater station with standby only)	8835339-5	96161
5F9	Fuse, cartridge, 0.2 amp., 250 v. (for terminal or repeater station only)	8835338-2	95109
5F10	Fuse, cartridge, 0.5 amp., 250 v. (for terminal stations with terminal service unit, junction terminal or repeater stations with filter and relay panels, or service channel bridge)	8835338-8	56069

DPS-4

Symbol No.	Description	Drawing No.	Stock No.
5F10	Fuse, cartridge, 1.25 amp., 125 v. (for terminal stations with service channel unit and indicon decoder, repeater stations with service channel unit and indicon coder or decoder)	8835338-12	215880
5F10	Fuse, cartridge, 0.8 amp., 250 v. (for repeater station with repeater service unit)	8835338-4	95111
5F10	Fuse, cartridge, 2.5 amp., 125 v. (for junction terminal or repeater stations with baseband bridge MI-31151 and relay panel or service channel bridge)	8835338-11	97446
5F11	Fuse, cartridge, 0.2 amp., 250 v. (for terminal or repeater station only) Same as 5F9	8835338-2	95109
5F12	Fuse, cartridge, 0.3 amp., 250 v. (for terminal or repeater station only)	8835338-3	95110
5F13, 5F14	Fuse, cartridge, 0.8 amp., 250 v. (for terminal or repeater station only)	8835338-4	95111
5F15	Fuse, cartridge, 0.2 amp., 250 v. (for terminal or repeater station only) Same as 5F9	8835338-2	95109
5F15	Fuse, cartridge, 0.8 amp., 250 v. (for terminal or repeater station with standby only) Same as 5F13	8835338-4	95111
5F16	Fuse, cartridge, 0.3 amp., 250 v. (for repeater station only) Same as 5F12	8835338-3	95110
5F16	Fuse, cartridge, 0.8 amp., 250 v. (for repeater station with standby only) Same as 5F13	8835338-4	95111
5F17	Fuse, cartridge, 0.3 amp., 250 v. (for terminal station only) Same as 5F12	8835338-3	95110
5F17	Fuse, cartridge, 0.8 amp., 250 v. (for repeater station only) Same as 5F13	8835338-4	95111
5F17	Fuse, cartridge, 2.5 amp., 125 v. (for terminal or repeater station with standby only)	8835338-11	97446
5F18	Fuse, cartridge, 0.8 amp., 250 v. (for repeater station only) Same as 5F13	8835338-4	95111
5F18	Fuse, cartridge, 2.0 amp., 125 v. (for terminal or repeater station with standby only)	8835338-5	95557
5I1	Lamp, pilot light, 120 v., 0.05 amps., 6 w. clear candlelabra screw base	61114-9	23216
5J1 to 5J4	Connector, female, 6 contact, chassis mtg.	181494-4	18534
5J5	Connector, male, 6 contact, chassis mtg.	181494-3	28507
5K3	Relay, ac, time delay, coil 115 v., 50/60 cy., 3.5 to 5 watts	470877-1	204348
5L1, 5L2	Reactor, iron core, 5 henry	949378-1	95372
5L3, 5L4	Reactor, iron core, 10 henry	949379-1	95373
5M1	Meter, elapsed time, 0-99,999 hours	8833317-1	95389
5P1	Connector, male, 6 contact, cable mtg.	181494-2	28454
5R1	Resistor, fixed, wire wound, 500 ohms, ±5%, 10 w.	8817663-14	96267
5R2	Resistor, variable, wire wound, 500 ohms, ±10%, 25 w.	108406-5	95374
5R3	Resistor, fixed, wire wound, 50,000 ohms, ±10%, 100 w.	449695-18	98116
5R4	Resistor, fixed, wire wound, 25,000 ohms, ±10%, 50 w.	182120-12	98117
5S1, 5S2	Switch, toggle, DPST, 15 amps., 125 v., 10 amps., 250 v.	449663-109	56882
5T1	Transformer, filament	949375-1	95376
5T2	Transformer, plate, pri. 115/124 v., sec. 355-0-355 v.	949376-1	95377
5T3	Transformer, plate, pri. 124 v., sec. 645-0-645 v.	949377-1	95378
5X1 to 5X4	Socket, tube, for UX-4 pin tubes, with underwriters shield, brkt. type and upright panel mtg. (special)	8843563-1	93654
5X5	Pilot light assy. (red)	458948-1	
5X6 to 5X8	Holder, fuse, panel mtg., for 1½" lg. x 13/32" dia. fuse	8871827-1	95379
5X9 to 5X18	Fuse, holder, cartridge, panel mtg. for 1¼" x 9/32" dia. fuses	99088-1	58933
	Socket, pilot light socket only less lamp and jewel (pt. of 5X5)	458948-1	95380
	Jewel, pilot light red jewel only, less socket and lamp (pt. of 5X5)	458948-1	95381
	Miscellaneous		
	Connector, tube cap, with 36" cable	896952-502	33288

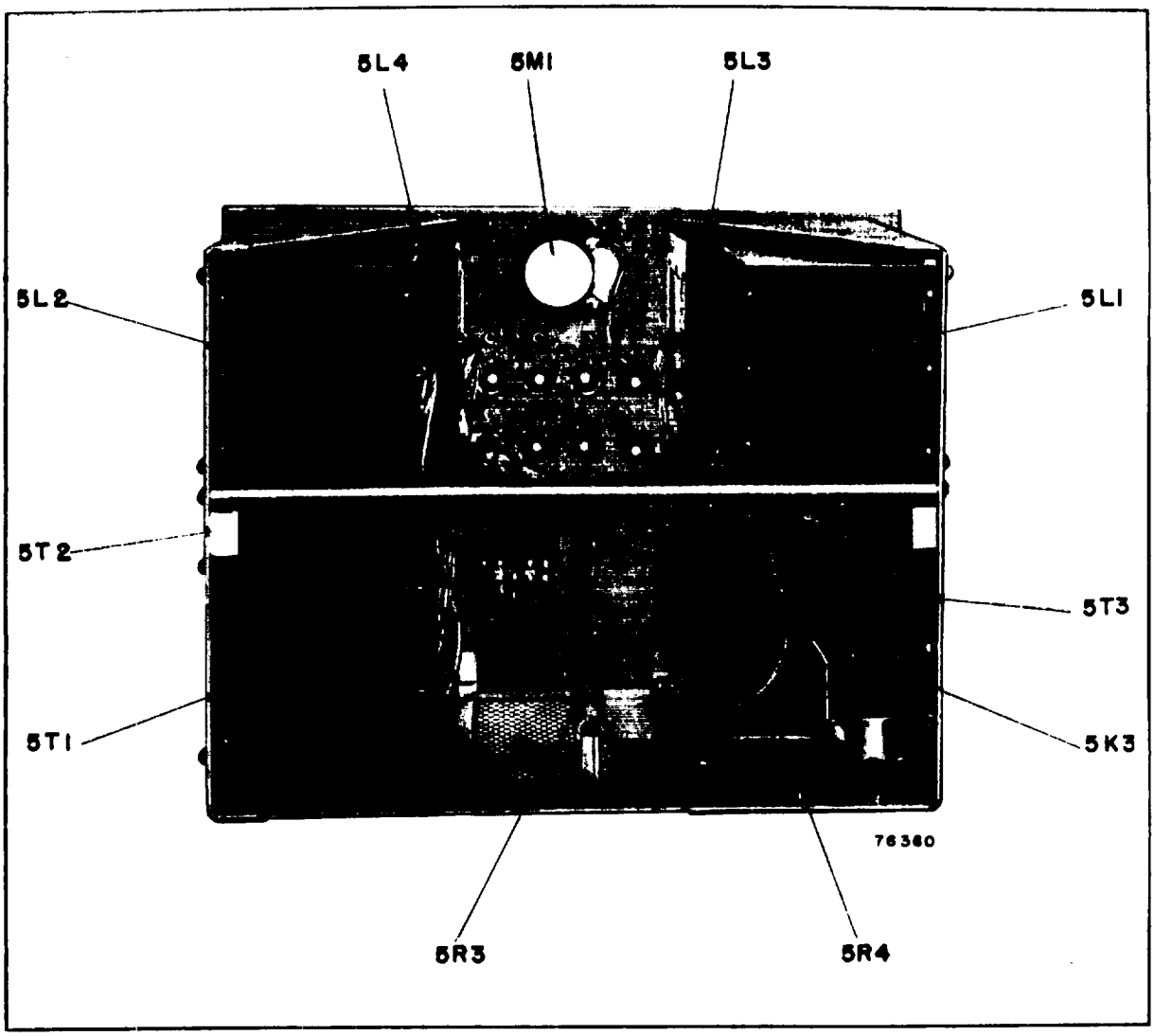


Figure PS-2—Power Supply, MI-31494-B—Rear View, Dust Cover Removed

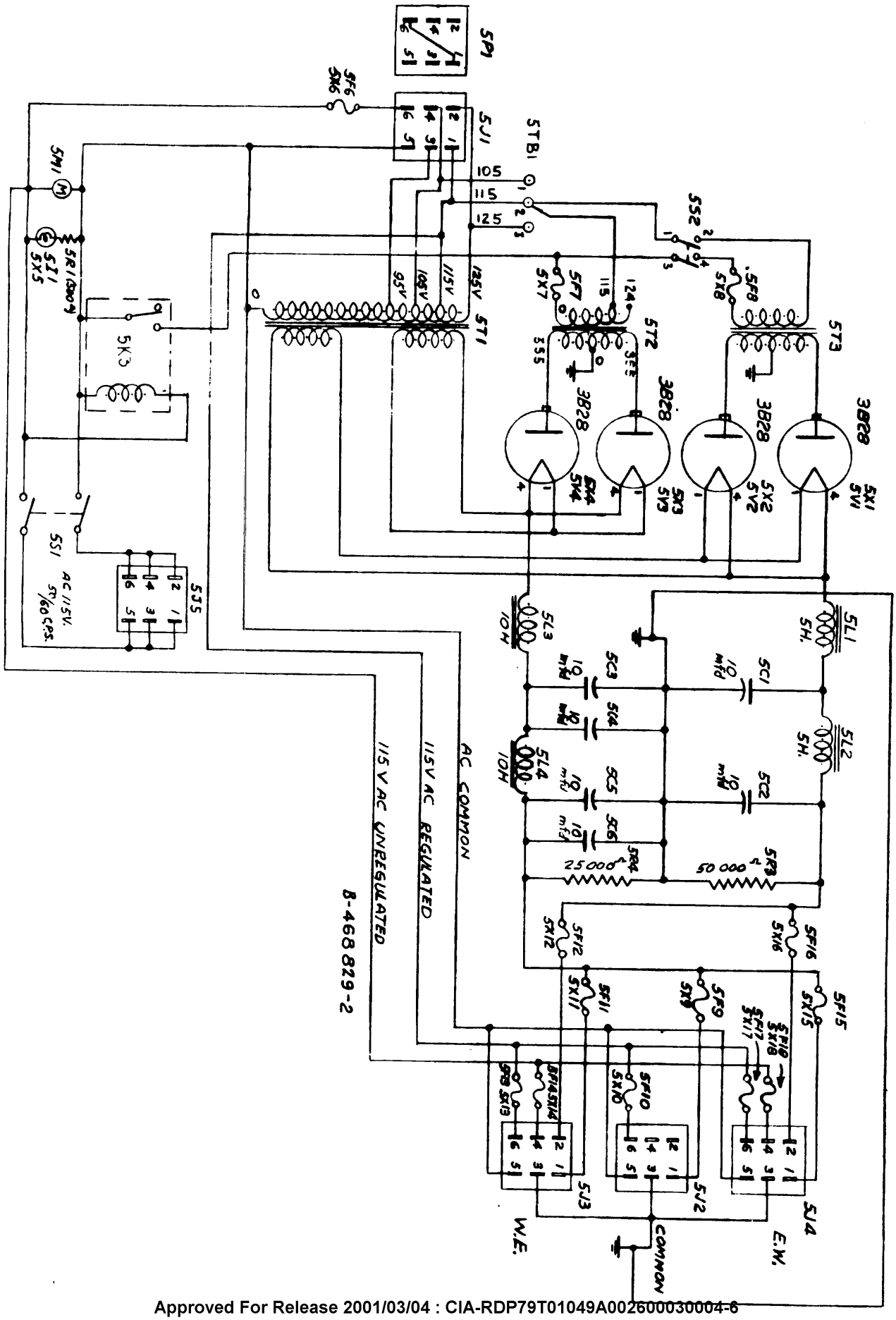


Figure PS-3—Power Supply, MI-31494-B—Schematic Diagram

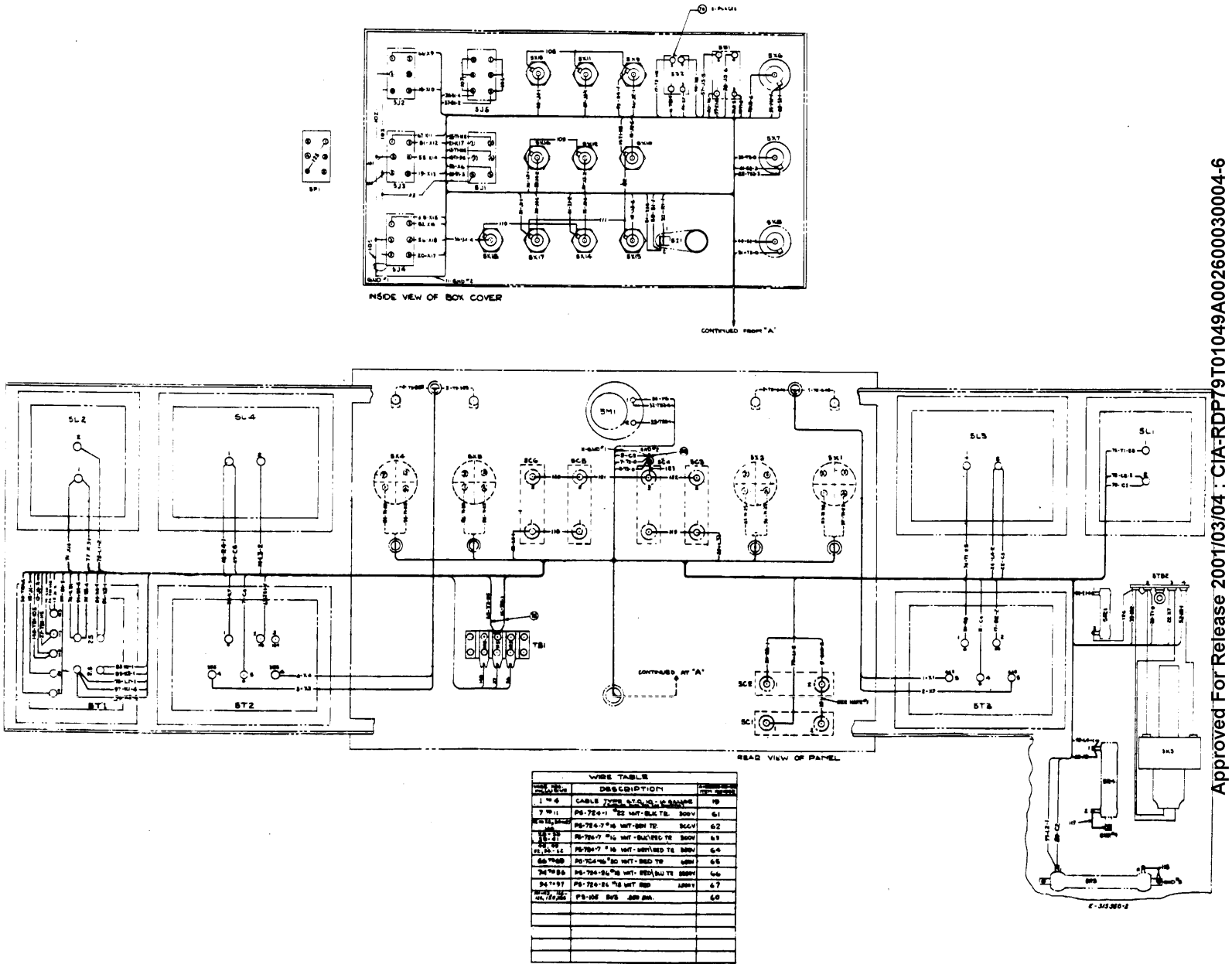


Figure PS-4—Power Supply, MI-31494-B—Connection Diagram

Approved For Release 2001/03/04 : CIA-RDP79T01049A002600030004-6

E

MICROWAVE COMMUNICATION EQUIPMENT

T.O. 31R5-4-A-21

Terminal AFC Unit MI-31492-C

- TECHNICAL DATA
- DESCRIPTION
- MAINTENANCE
- REPLACEMENT PARTS

RADIO CORPORATION OF AMERICA
COMMUNICATION PRODUCTS DEPARTMENT, CAMDEN, NEW JERSEY

PRINTED IN U.S.A.
DU 5A

IB-33228-2

TECHNICAL DATA

Power Input

a. Filament Heaters: 19 watts at 115 v, 50/60 cycles ac

b. Plate Supply: 95 milliamps at 250 v dc

I-F Frequency

20 mc

Bandwidth

2 mc

Required R-F Input

1 mw

110 MC Output

2 volt

Weight and Dimensions

Weight—7 lbs.
Height—5¼"
Depth Back of Panel: 2⅞"
Depth Front of Panel: 2½"
Width—19" Rack Mounting

Crystals

Symbol	*Type*	*Function*
3CR1	1N21B	AFC Mixer
3Y1	MI-31687-* (See Note)	Beating Oscillator

Tube Complement

Symbol	*Type*	*Function*
3V1	6CB6	First i-f Amplifier
3V2	6CB6	Second i-f Amplifier
3V3	6CB6	Third i-f Amplifier
3V4	6CB6	Fourth i-f Amplifier
3V5	6AL5	Discriminator
3V6	12AT7	Oscillator/Multiplier
3V7	6U8	55 MC Amplifier and Multiplier
3V8	6CB6	55 MC Oscillator
3V9	6AH6	Reactance Control

NOTE: The letter-number suffix (*) of the MI-31687 crystal series is determined by the system frequency assignment. Consult the system instructions for Typical System Frequencies.

DESCRIPTION

The Terminal AFC Unit (MI-31492-C) is designed for mounting in either a standard 19" open rack or cabinet. It is mounted adjacent to the transmitter unit and is used in terminal stations only. This unit keeps the terminal transmitter stabilized at its assigned frequency. This is extremely important because the frequency of the whole relay chain is controlled by the terminal station transmitter frequency.

The transmitter frequency is compared with a reference frequency from a quartz crystal controlled oscillator. The error voltage is used to change the frequency of a 55 mc oscillator, the frequency of which is doubled in the multiplier stage. The multiplier output changes the receiver/modulator I-F mixer frequency which corrects the transmitter carrier frequency.

AFC-2

1. The basic control frequency of the Terminal AFC Unit MI-31492-C is generated by the crystal controlled oscillator/multiplier 3V6. The frequency of the quartz crystal 3Y1 of the crystal oscillator 3V6 is calculated from the following equation:

$$F_c = \frac{F_t + F_r}{2X}$$

where: F_c is the frequency of the quartz crystal 3Y1 of the crystal oscillator
F_t is the transmitted frequency
F_r is the received frequency
X is the multiple of the crystal frequency and is found in the following table:

Range of $\frac{F_t + F_r}{2}$	*Value of X*
1720 mc to 1840 mc	44
1841 mc to 2000 mc	48
2001 mc to 2160 mc	52
2161 mc to 2320 mc	56
2321 mc to 2470 mc	60
2471 mc to 2640 mc	64
2641 mc to 2680 mc	68

Refer to the systems book for Typical System Frequencies.

2. The oscillator/multiplier 3V6 generates the heterodyning frequency required in the 3Z1 mixer cavity. The plate circuit of the oscillator section of 3V6 is tuned to the frequency of the crystal (3Y1). The plate circuit of the multiplier section of 3V6 is tuned to the 4th harmonic of the crystal. The output of this stage is fed to the 1N21B crystal in the resonant mixer cavity 3Z1. The other mixer frequency is a sample of the microwave transmitter output which is fed by coaxial cable to the R.F. CARRIER INPUT terminal 3J1 of mixer cavity 3Z1. The transmitter frequency is heterodyned with a high order harmonic of the crystal multiplier to produce a difference frequency of 20 mc. The actual harmonic used may be from the 11th to the 17th depending on the

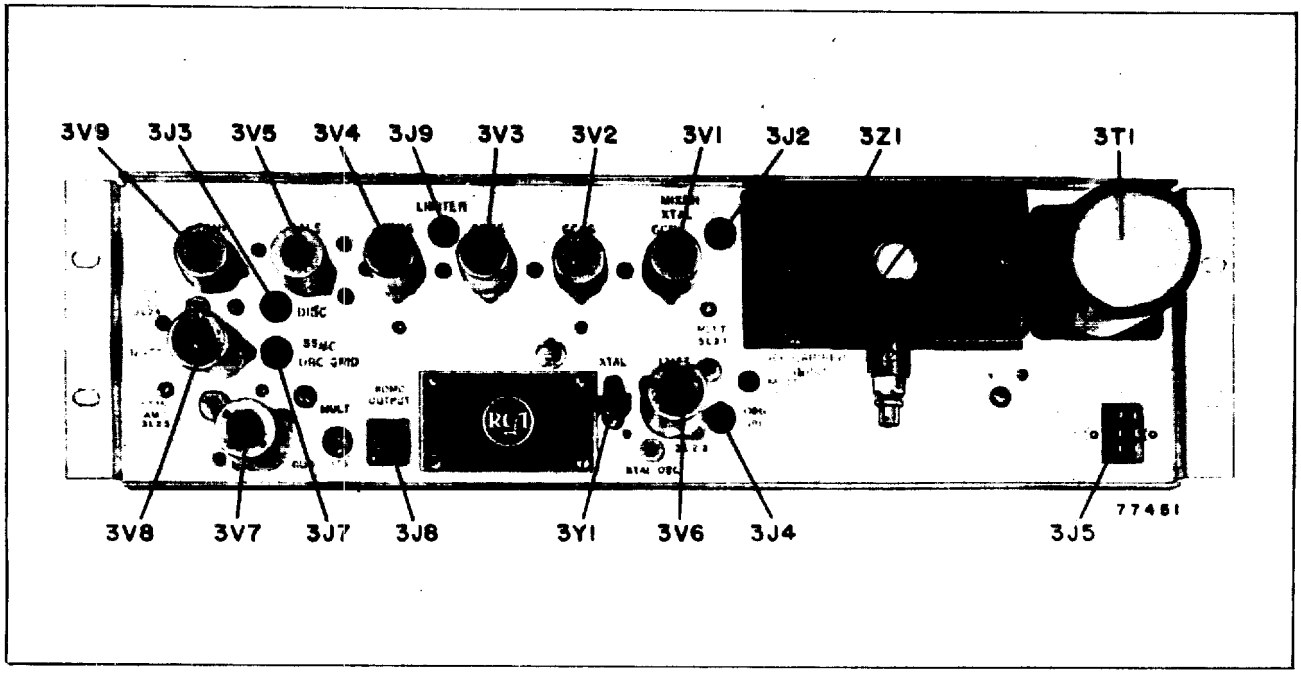


Figure AFC-1—Terminal AFC Unit, MI-31492-B and MI-31492-C—Front View

frequency of the transmitter. The harmonic used is found by dividing the value of X in the equation, by four. The adjustable screw in the cavity tunes it to the frequency of the signal from the transmitter and the adjustable loop inside terminal 3J1 controls the amount of the signal input.

With the transmitter operating on its specified frequency the i-f output of 3Z1 is 20 mc. The mixer output is amplified through four i-f stages and then applied to discriminator 3V5 which is tuned to 20 mc. A 20 mc signal will cause a 0 discriminator output. Any variation of the transmitter frequency will change the frequency of the i-f input to 3V5 with a resultant dc discriminator output voltage. The dc voltage from 3V5 is applied to the reactance circuit of 3V9 which changes the frequency of the 55 mc oscillator (3V8) relative to the amount of dc applied to 3V9 from the discriminator. The 55 mc output of 3V8 is doubled in the amplifier/multiplier stage 3V7. A change in the 110 mc output of 3V7 occurs only if the transmitter output frequency tends to drift. The 110 mc output of 3V7 is fed to mixer 2V10 in the receiver/modulator unit.

In the receiver/modulator unit the 110 mc output of the AFC unit heterodynes with the 40 mc f-m signal in mixer stage 2V10 to produce the 70 mc subcarrier which modulates the microwave carrier. Any variation in the 110 mc output frequency of the AFC unit will cause 2V10 to either increase or decrease the frequency of the 70 mc signal carrier. Any fluctuation (increase or decrease) in the transmitter local oscillator (1V2) frequency will be compensated for in the transmitter mixer stage (1V3) by a corresponding decrease or increase in the 70 mc carrier frequency, thereby correcting the transmitted microwave carrier frequency. (Refer to the terminal station block diagram of the system book for the automatic frequency control circuit.)

CONTROLS

a. The XTAL OSC tuning screw is for adjusting the plate peaking coil 3L22 of the crystal oscillator (the 1-2-3 section of 3V6) to the crystal frequency.

b. The OSC GRID pin jack 3J4 is used to connect meter 1M1 to indicate when the crystal oscillator (1-2-3 of 3V6) is tuned (by the XTAL OSC screw) to the frequency of the crystal 3Y1.

c. The MULT tuning screws of coils 3L21 and 3L17 are for adjusting the multiplier stage (the 6-7-8 section of 3V6) to the 4th harmonic of the crystal oscillator.

d. The MIXER XTAL pin jack 3J2 is used to connect meter 1M1 to indicate when the multiplier stage (6-7-8 of 3V6) is tuned to the 4th harmonic of the crystal oscillator.

e. The crystal mixer cavity R.F. CARRIER INPUT terminal 3J1 is the receptacle for connecting the cable which supplies a sample of the output frequency from the transmitter.

f. The tuning screw of the crystal mixer cavity is for resonating the cavity to the frequency of the transmitter.

g. The LIMITER pin jack 3J9 is for connecting meter 1M1 to show when the crystal mixer cavity is tuned to resonance at the transmitter frequency.

h. The DISC pin jack 3J3 is used to connect meter 1M1 when checking the discriminator dc voltage output when tuning the AFC and transmitter.

i. The 55 MC OSC tuning screw of coil 3L24 is for adjusting the frequency of the 55 mc oscillator 3V8.

j. The 55 MC OSC GRID pin jack 3J7 is used to connect meter 1M1 to check the grid current when adjusting 3V8 to 55 mc with the 55 MC OSC tuning screw.

k. The 55 MC AMP tuning screw of coil 3L23 is for adjusting the frequency of the 55 mc amplifier stage (the pentode section, elements 7-2-3-6, of 3V7).

l. The MULT 3T3 tuning screw of transformer 3T3 is for adjusting the frequency of the 110 mc amplifier stage (the triode section, elements 8-9-1, of 3V7).

m. The 110 MC OUTPUT jack 3J8 is used to connect the output of the 110 mc multiplier stage (3V7-8-9-1) to the 110 MC INPUT jack of the receiver.

AFC-4

MAINTENANCE

General Notes

a. To check the operation of the AFC unit connect the test meter, 1M1, test lead to the "DISC" jack. 1M1 should read zero. When the transmitter oscillator cavity is squeezed, the 1M1 reading should increase to approximately 50 μa if the AFC unit is working properly.

b. If the transmitter r-f output fails completely one of the possible causes could be the failure of the terminal AFC unit to deliver a 110 mc signal to the modulator i-f mixer of the receiver/modulator. There is no 70 mc drive to the transmitter during the absence of the 110 mc frequency from the terminal AFC unit.

c. If the terminal AFC unit is the cause of the transmitter failure, check the tubes and replace the ones that are bad. The four i-f tubes and discriminator tube (3V1 thru 3V5) can be changed without retuning any of the circuits. If the oscillator/multiplier tube 3V6 is changed, tuning coils 3L21, 3L22, 3L17, 3L16, 3L15 and 3C39 should be repeaked as follows:

1. Connect the transmitter test meter 1M1 to the OSC GRID 3J4 and tune the XTAL OSC control 3L22 for maximum grid current. A reading of at least 70 μa should be obtained.

2. Connect meter 1M1 to the MIXER XTAL jack 3J2 and tune the MULT controls 3L21 and 3L17 for maximum current. Since this is a double tuned circuit it is advisable to keep the cores at about the same depth, when tuning over any great range, in order to get an initial reading to maximize. The meter reading should be 25 μa or more. (To obtain a peak indication when tuning this circuit it may be necessary to remove the r-f cable connecting the transmitter output to the crystal cavity on the terminal AFC unit. The cable should be replaced immediately after peaking the circuit.)

d. If either the 55 mc oscillator, 110 mc multiplier or reactance tube (3V8, 3V7, 3V9) is changed, the tuned circuits of these stages should be retuned as described in the CIRCUIT ALIGNMENT section, and the operation of the AFC system checked as follows:

Check the terminal AFC unit discriminator reading by connecting the test meter 1M1 to the jack marked "DISCR". If the meter reading is not zero, adjust the 55 MC OSC control 3L24 very slowly until the meter reads zero. The transmitter AFC motor may run when the 55 mc oscillator frequency is changed slightly. After a slight change in the frequency of the 55 mc oscillator is made, wait for the AFC tuning motor indicator light to go out before continuing adjustment. Keep adjusting 3L24 in this manner until the DISC reading is zero. If this adjustment is considerably off the correct point, a zero discriminator current will also be observed, but in this case of improper adjustment, there will be a very small reading of limiter current on this unit instead of the normal value of 25 μa or more. After the zero reading is reached tune the 55 MC AMP and MULT 3T3 controls for maximum output at 3J8 as described in item (b) of the 55 MC Oscillator/Multiplier Circuit test in the following CIRCUIT ALIGNMENT section.

CIRCUIT ALIGNMENT

The following headings contain detailed alignment and test procedure for all the circuits of the terminal AFC unit. These tests and alignments should be made with the unit on a test bench. The test items specified in the following procedures refer to the test equipment items listed in the test equipment tables of the system instructions. Use test item 19 to supply power to operate the terminal AFC unit.

Crystal Oscillator Circuit Test

Connect the microammeter to 3J4 (OSC GRID) and adjust the XTAL OSC control 3L22 for maximum grid current as indicated on the meter. A current reading of 80 μa or more indicates satisfactory operation.

Multiplier Circuit Tuning Adjustment

Connect the microammeter to 3J2 (MIXER CRYSTAL) and tune the MULT controls 3L21 and 3L17 for maximum current. A reading of 50 μa is adequate. Be sure the current can be maximized by tuning either coil.

55 Mc Oscillator/Multiplier Circuit Test

a. Connect the microammeter to 3J7. Ground the junction of 3R35 and 3R37. With the core of 3L25 in the mid-position adjust the 55 MC OSC

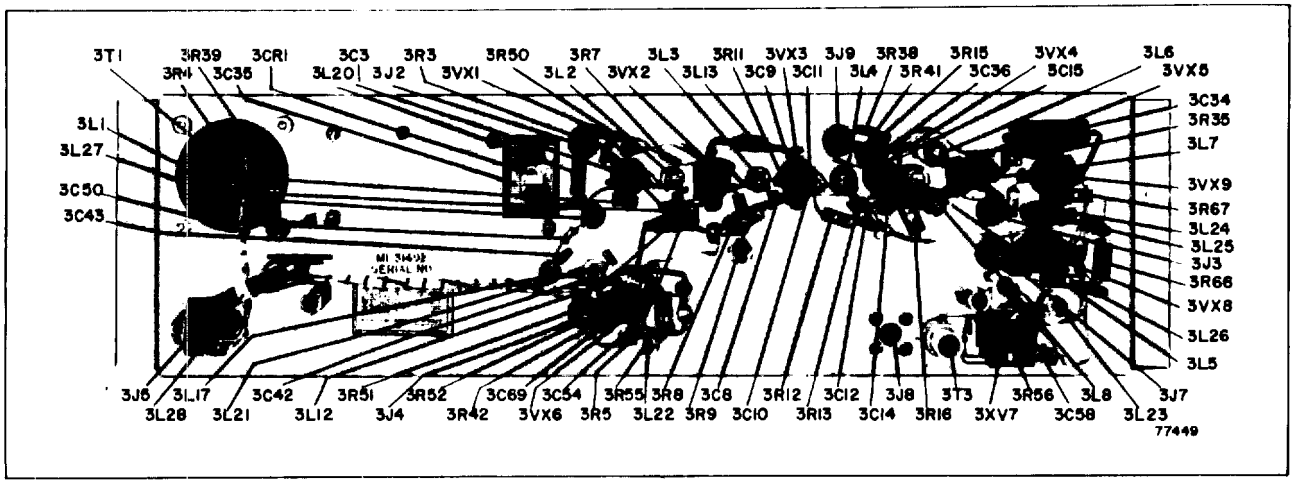


Figure AFC-2—Terminal AFC Unit, MI-31492-C—Rear View, Dust Cover Removed

control 3L24 for a frequency of 55 mc. (Use test item 13). Adjust 3L25 for a reading of 55 μa. Readjust the frequency, if necessary, to 55 mc $\pm$0.1 mc.

b. Connect the r-f voltmeter (test item 22) to the 110 MC OUTPUT jack 3J8 and adjust the 55 MC AMP Control 3L23 and the MULT 3T3 control for maximum output. A reading of at least 2 volts must be obtained.

Discriminator and I-F Alignment

a. Connect the CRO to 3V5-5.

b. Connect the 20 mc sweep generator (test item 18) output to 3V4-1.

c. Adjust 3L5, 3L6, and 3L8 for the correct discriminator response. No great amount of time should be spent in obtaining exact linearity. It is essential that the alignment be such that the discriminator peaks are 3 mc apart and that crossover is located at 20 mc. Remove the sweep generator and oscilloscope.

d. Connect the microammeter to the LIMITER jack 3J9.

e. Connect the signal generator (test item 16) to 3V3-1 and set it for exactly 20 mc.

f. Tune 3L4 for a maximum meter reading. Reduce the signal generator output for a meter reading of approximately 50 μa.

g. Move the signal generator to 3V2-1 and tune 3L3 for a maximum reading at 3J9. Adjust the signal generator for a meter reading at 3J9 of approximately 50 μa.

h. Move the signal generator to 3V1-1 and tune 3L2 for a maximum reading at 3J9. Adjust the signal generator for a meter reading at 3J9 of approximately 50 μa.

i. Connect the Voltohmyst probe to 3V5-1. Use the most sensitive scale. While maintaining the signal generator output to produce limiter saturation, tune 3L6, 3L7 and 3L8 so the crossover voltage is exactly at 20 mc and the two peaks are at 18.5 and 21.5 mc $\pm$0.2 mc and of approximately equal amplitude. Coil 3L7 controls the amplitude, 3L6 the high frequency peak and 3L8 the low frequency peak. Remove the signal generator, microammeter and Voltohmyst.

I.F. Gain Measurement

a. Connect the microammeter to 3J9 (LIMITER).

b. Remove the 1N21B from its socket.

c. Connect the 20 mc signal generator to the low end of 3L1.

d. With sufficient output to get a small reading on the microammeter tune 3L1 for a maximum response at 20 mc.

e. It should now require not more than 2000 μv to obtain a reading of 100μa at 3J9 (LIMITER).

Reactance Tube Sensitivity Test

a. Connect the Voltohmyst to the DISC jack 3J3 with the signal generator connected as in (c) of the I-F Gain Measurement test.

b. Tune the signal generator to 20 mc for a zero reading at 3J3.

AFC-6

c. With the conditions as above, tune the 55 MC OSC control 3L24 for a 55 mc ±0.1 mc frequency reading. Measure the frequency at the 110 MC OUTPUT jack 3J8 using test item 13.

d. Change the frequency of the 20 mc signal generator until the Voltohmyst reads 1 volt and again measure the frequency at 3J8. The difference between this measurement and that at (c) should not be less than ±1 mc.

R-F Mixer Circuit Test

a. Replace the 1N21B.

b. Orient the plane of the loop on 3J1 (R-F CARRIER INPUT) perpendicular to the long axis of 3Z1.

c. With the unit operating normally, connect the 2700 mc signal generator (test item 17) to R-F CARRIER INPUT 3J1.

d. Connect the microammeter to 3J9 (LIMITER).

e. With the signal generator set for approximately 1 milliwatt output, tuning the signal generator to the correct frequency should give a response in the i-f amplifier as indicated on the microammeter.

NOTE: There are several frequencies that will give a response. For a given crystal frequency, signal generator frequencies at which a response will be obtained are equal to the crystal frequency, in megacycles, multiplied by 44, 48, 52, 56, 60, 64 or 68 with 20 mc added or subtracted from the product.

f. 3Z1 should be tuned for a maximum i-f response. The reading at 3J9 must be at least 40 ma.

g. Retune 3L1 for maximum response.

TYPICAL TERMINAL AFC VOLTAGE AND METER READINGS

The following are approximate voltages existing between the indicated tube pins and ground as measured with a Voltohmyst with 100,000 ohms in series with the measuring probe. All voltages are dc unless otherwise noted.

Tube	*Type*	*Function*	*Pin #1*	*Pin #2*	*Pin #3*	*Pin #4*	*Pin #5*	*Pin #6*	*Pin #7*	*Pin #8*	*Pin #9*
3V1	6CB6	I-F Ampl.	0	2	6.3 ac	0	210	140	0	—	—
3V2	6CB6	I-F Ampl.	0	2	6.3 ac	0	210	140	0	—	—
3V3	6CB6	I-F Ampl.	0	2	6.3 ac	0	210	140	0	—	—
3V4	6CB6	Limiter	0	1.2	6.3 ac	0	60	80	0	—	—
3V5	6AL5	Detector	0	var*	6.3 ac	0	var*	0	var.*	—	—
3V6	12AT7	Crystal Osc./Mult.	180	0	2.7 ac	0	0	220	0	9.6	6.3 ac
3V7	6U8	55 mc Amp./110 mc Mult.	130	0	110	0	6.3 ac	200	1.6	2.5	0
3V8	12AT7	55 mc Osc.	160	0	0	0	0	160	0	0	6.3 ac
3V9	6AH6	React.	var*	3.3	6.3 ac	0	160	140	3.3	—	—

var*—variable with signal level and frequency.

The following are typical meter readings obtained using the 200 microampere test meter (1M1) in the transmitter unit.

Mixer Xtal. (3J2)	— −15 to −75 μa
Disc. (3J3)	— zero for on-frequency operation; up to off scale plus or minus for off-frequency operation
Osc. Grid (3J4)	— −110 μa
55 mc Os. Grid (3J7)	— −45 μa
Limiter (3J9)	— −25 μa

REPLACEMENT PARTS LIST

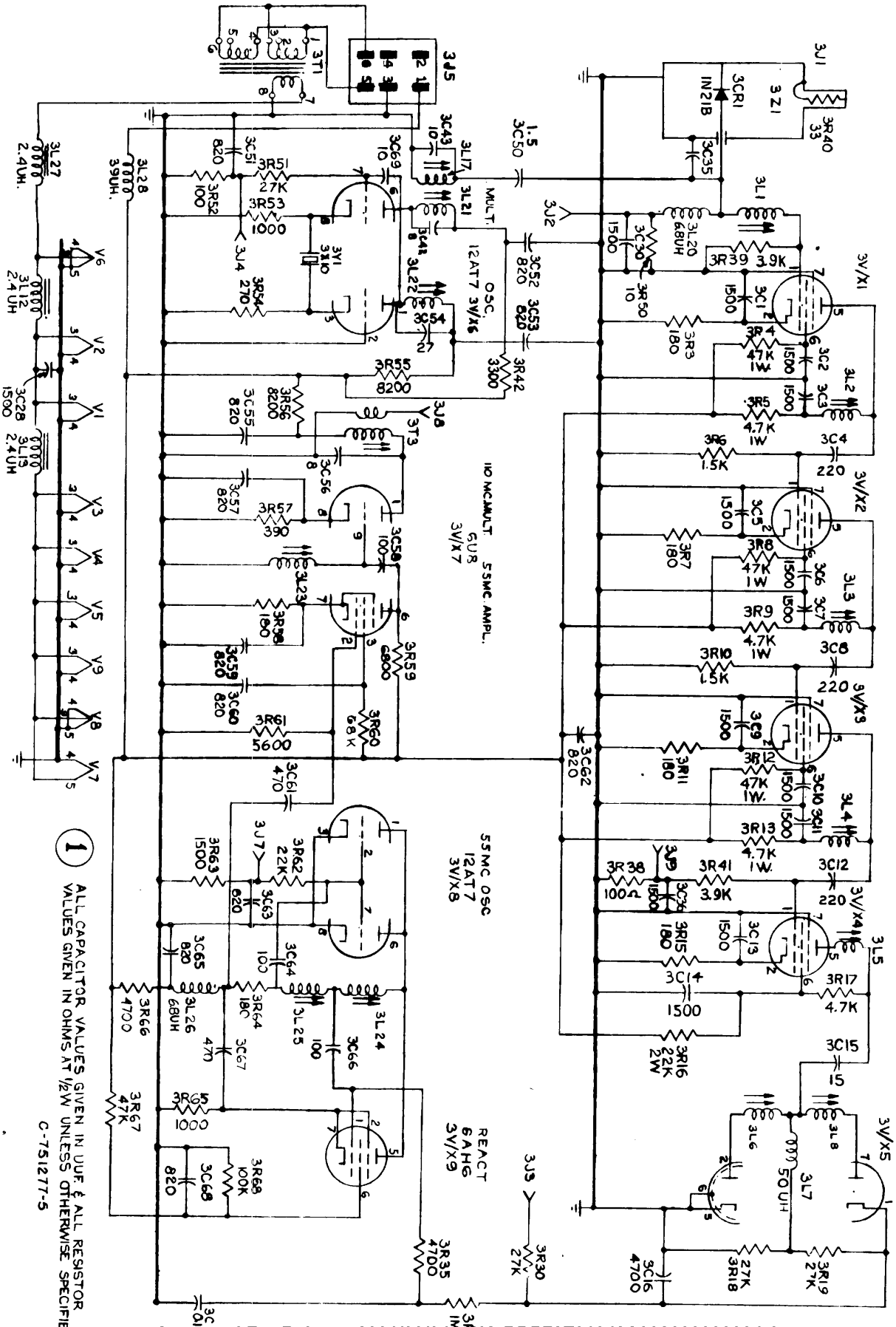
TERMINAL AFC UNIT—MI-31492-C

Symbol No.	*Description*	*Drawing No.*	*Stock No.*
3C1, 3C2, 3C3	Capacitor, fixed ceramic, 1500 mmf, +100 –0%, 500 v.	449696-3	73748
3C4	Capacitor, fixed ceramic, 220 mmf, ±20%, 500 v.	735717-133	102015
3C5, 3C6, 3C7	Capacitor, fixed ceramic, 1500 mmf, +100 –0%, 500 v. Same as 3C1	449696-3	73748
3C8	Capacitor, fixed ceramic, 220 mmf, ±20%, 500 v. Same as 3C4	735717-133	102015
3C9, 3C10, 3C11	Capacitor, fixed ceramic, 1500 mmf, +100 –0%, 500 v. Same as 3C1	449696-3	73748
3C12	Capacitor, fixed ceramic, 220 mmf, ±20%, 500 v. Same as 3C4	735717-133	102015
3C13, 3C14	Capacitor, fixed ceramic, 1500 mmf, +100 –0%, 500 v. Same as 3C1	449696-3	73748
3C15	Capacitor, fixed ceramic, 15 mmf, ±20%, 500 v.	735717-119	94195
3C16	Capacitor, fixed ceramic, 4700 mmf, ±100 –0%, 500 v.	990119-11	73473
3C17 to 3C27	Not used.		
3C28	Capacitor, fixed ceramic, 1500 mmf, +100 –0%, 500 v. Same as 3C1	449696-3	73748
3C29	Not used.		
3C30	Capacitor, fixed ceramic, 1500 mmf, +100 –0%, 500 v. Same as 3C1	449696-3	73748
3C31, 3C32, 3C33	Not used.		
3C34	Capacitor, fixed paper, 0.1 mf, ±10%, 400 v.	735715-175	73551
3C35	Part of 3Z1.		
3C36	Capacitor, fixed ceramic, 1500 mmf, +100 –0%, 500 v. Same as 3C1	449696-3	73748
3C37 to 3C41	Not used.		
3C42	Capacitor, fixed mica, 8 mmf, ±5%, 300 v.	748252-308	205068
3C43	Capacitor, fixed mica, 10 mmf, ±5%, 300 v.	748252-310	59905
3C44 to 3C49	Not used.		
3C50	Capacitor, fixed ceramic, 1.5 mmf, ±0.25 mmf, 500 v.	722401-54	78928
3C51, 3C52, 3C53	Capacitor, fixed ceramic, 820 mmf, +100 –0%, 500 v.	449696-1	94190
3C54	Capacitor, fixed ceramic, 27 mmf, ±5%, 500 v.	90575-219	79488
3C55	Capacitor, fixed ceramic, 820 mmf, +100 –0%, 500 v. Same as 3C51	449696-1	94190
3C56	Capacitor, fixed ceramic, 8 mmf, ±0.5 mmf, 500 v.	90575-207	99600
3C57	Capacitor, fixed ceramic, 820 mmf, +100 –0%, 500 v. Same as 3C51	449696-1	94190
3C58	Capacitor, fixed ceramic, 100 mmf, ±20%, 500 v.	735717-129	101853
3C59, 3C60	Capacitor, fixed ceramic, 820 mmf, +100 –0%, 500 v. Same as 3C51	449696-1	94190
3C61	Capacitor, fixed ceramic, 470 mmf, ±20%, 500 v.	735717-637	75198
3C62, 3C63	Capacitor, fixed ceramic, 820 mmf, +100 –0%, 500 v. Same as 3C51	449696-1	94190
3C64	Capacitor, fixed ceramic, 100 mmf, ±20%, 500 v. Same as 3C58	735717-129	101853
3C65	Capacitor, fixed ceramic, 820 mmf, +100 –0%, 500 v. Same as 3C51	449696-1	94190
3C66	Capacitor, fixed ceramic, 100 mmf, ±20%, 500 v. Same as 3C58	735717-129	101853
3C67	Capacitor, fixed ceramic, 470 mmf, ±20%, 500 v. Same as 3C61	735717-637	75198
3C68	Capacitor, fixed ceramic, 820 mmf, +100 –0%, 500 v. Same as 3C51	449696-1	94190
3C69	Capacitor, fixed ceramic, 10 mmf, ±0.5 mmf, 500 v.	90575-209	98225
3CR1	Rectifier, germanium diode	1N21B	67876
3J1	Connector, female, coaxial, coupling loop assembly, chassis mtg.	8834436-501	94231
3J2, 3J3, 3J4	Connector, female, pin jack	742565-1	93678
3J5	Connector, male, 6 contact, chassis mtg.	181494-3	28507
3J6	Not used.		
3J7	Connector, female, pin jack. Same as 3J2	742565-1	93678
3J8	Connector, female, coaxial, chassis mtg.	8845666-1	94205
3J9	Connector, female, pin jack. Same as 3J2	742565-1	93678

AFC-8

Symbol No.	*Description*	*Drawing No.*	*Stock No.*
3L1	Coil, adj. iron core	629132-507	94240
3L2, 3L3, 3L4	Coil, adj. iron core	629132-508	94250
3L5	Coil, adj. iron core	629132-501	94251
3L6	Coil, adj. iron core	629132-505	94236
3L7	Reactor, r-f choke, 50 microhenrys	8834437-502	94242
3L8	Coil, adj. iron core. Same as 3L5	629132-501	94251
3L9, 3L10, 3L11	Not used.		
3L12	Reactor, r-f choke, 2.4 microhenrys	8834424-501	94040
3L13	Reactor, r-f choke, 2.4 microhenrys. Same as 3L12	8834424-501	94040
3L14 to 3L16	Not used.		
3L17	Coil, adj. core, mult. plate tuning, 160 mc.	8864102-4	204735
3L18, 3L19	Not used.		
3L20	Reactor, r-f choke, 6.8 microhenrys	941524-245	217800
3L21	Coil, adj. core, mult. plate tuning, 160 mc. Same as 3L17	8864102-4	204735
3L22	Coil, adj. core, osc. plate tuning, 40 mc.	8864102-2	204736
3L23	Coil, adj. core, 55 mc. plate output tuning	8864101-1	204737
3L24	Coil, adj. core, osc. plate tuning, 55 mc.	8864102-3	204738
3L25	Coil, adj. core, osc. grid tuning, 55 mc.	629132-517	94245
3L26	Reactor, r-f choke, 6.8 microhenrys. Same as 3L20	941524-245	217800
3L27	Reactor, r-f choke, 2.4 microhenrys. Same as 3L12	8834424-501	94040
3L28	Reactor, r-f choke, 39 microhenrys	473909-39	205859
3R1, 3R2	Not used.		
3R3	Resistor, fixed composition, 180 ohm, ±10%, ½ w.	82283-53	
3R4	Resistor, fixed composition, 47,000 ohm, ±10%, 1 w.	90496-82	
3R5	Resistor, fixed composition, 4700 ohm, ±20%, 1 w.	90496-17	
3R6	Resistor, fixed composition, 1500 ohm, ±10%, ½ w.	82283-64	
3R7	Resistor, fixed composition, 180 ohm, ±10%, ½ w. Same as 3R3	82283-53	
3R8	Resistor, fixed composition, 47,000 ohm, ±10%, 1 w. Same as 3R4	90496-82	
3R9	Resistor, fixed composition, 4700 ohm, ±20%, 1 w. Same as 3R5	90496-17	
3R10	Resistor, fixed composition, 1500 ohm, ±10%, ½ w. Same as 3R6	82283-64	
3R11	Resistor, fixed composition, 180 ohm, ±10%, ½ w. Same as 3R3	82283-53	
3R12	Resistor, fixed composition, 47,000 ohm, ±10%, 1 w. Same as 3R4	90496-82	
3R13	Resistor, fixed composition, 4700 ohm, ±20%, 1 w. Same as 3R5	90496-17	
3R14	Not used.		
3R15	Resistor, fixed composition, 180 ohm, ±10%, ½ w. Same as 3R3	82283-53	
3R16	Resistor, fixed composition, 22,000 ohm, ±20%, 2 w.	99126-21	
3R17	Resistor, fixed composition, 4700 ohm, ±10%, ½ w.	82283-70	
3R18, 3R19	Resistor, fixed composition, 27,000 ohm, ±10%, ½ w.	82283-79	
3R20 to 3R29	Not used.		
3R30	Resistor, fixed composition, 27,000 ohm, ±10%, ½ w. Same as 3R18	82283-79	
3R31 to 3R34	Not used.		
3R35	Resistor, fixed composition, 4700 ohm, ±10%, ½ w. Same as 3R17	82283-70	
3R36	Not used.		
3R37	Resistor, fixed composition, 1 meg. ±20%, ½ w.	82283-31	
3R38	Resistor, fixed composition, 100 ohm, ±5%, ½ w.	82283-135	
3R39	Resistor, fixed composition, 3900 ohm, ±10%, ½ w.	82283-69	
3R40	Resistor, fixed composition, 33 ohm, ±10%, ½ w. (part of 3J1 assy).	82283-44	
3R41	Resistor, fixed composition, 3900 ohm, ±10%, ½ w. Same as 3R39	82283-69	
3R42	Resistor, fixed composition, 3300 ohm, ±10%, 1 w.	90496-68	
3R43, to 3R49	Not used.		

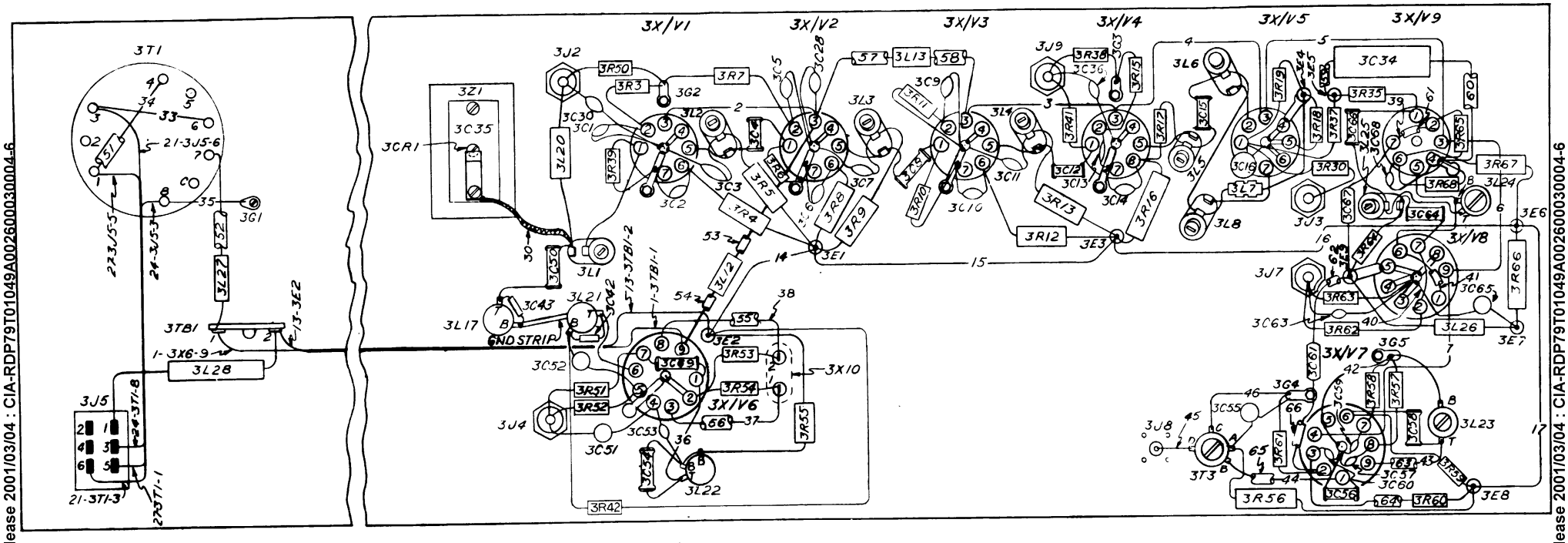
Symbol No.	*Description*	*Drawing No.*	*Stock No.*
3R50	Resistor, fixed composition, 10 ohm, ±10%, ½ w.	82283-38	
3R51	Resistor, fixed composition, 27,000 ohm, ±10%, ½ w. Same as 3R18	82283-79	
3R52	Resistor, fixed composition, 100 ohm, ±10%, ½ w.	82283-50	
3R53	Resistor, fixed composition, 1000 ohm, ±10%, ½ w.	82283-62	
3R54	Resistor, fixed composition, 270 ohm, ±10%, ½ w.	82283-55	
3R55, 3R56	Resistor, fixed composition, 8200 ohm, ±10%, 2 w.	99126-73	
3R57	Resistor, fixed composition, 390 ohm, ±10%, ½ w.	82283-57	
3R58	Resistor, fixed composition, 180 ohm, ±10%, ½ w. Same as 3R3	82283-53	
3R59	Resistor, fixed composition, 6800 ohm, ±10%, ½ w.	82283-72	
3R60	Resistor, fixed composition, 68,000 ohm, ±10%, ½ w.	82283-84	
3R61	Resistor, fixed composition, 5600 ohm, ±10%, ½ w.	82283-71	
3R62	Resistor, fixed composition, 22,000 ohm, ±10%, ½ w.	82283-78	
3R63	Resistor, fixed composition, 1500 ohm, ±10%, ½ w. Same as 3R6	82283-64	
3R64	Resistor, fixed composition, 180 ohm, ±10%, ½ w. Same as 3R3	82283-53	
3R65	Resistor, fixed composition, 1000 ohm, ±10%, ½ w. Same as 3R53	82283-62	
3R66	Resistor, fixed composition, 4700 ohm, ±10%, 2 w.	99126-70	
3R67	Resistor, fixed composition, 47,000 ohm, ±10%, 1 w. Same as 3R4	90496-82	
3R68	Resistor, fixed composition, 100,000 ohm, ±10%, ½ w.	82283-86	
3T1	Transformer, filament	949385-1	94196
3T2	Not used.		
3T3	Transformer, adj. core, multiplier output, 110 mc.	8864100-1	204739
3X1 to 3X5	Socket, 7 pin min.	737867-18	94879
3X6, 3X7, 3X8	Socket, 9 pin min.	984055-2	94880
3X9	Socket, 7 pin min. Same as 3X1	737867-18	94879
3X10	Socket, crystal, 2 contact, steatite	8885952-1	79970
3Z1	Cavity Assembly (associated parts below)	458907-501	
	Core, brass tuning core, 5/8-24 thread, 1 1/16" lg., 1Z1 tuning	8831031-1	95393
	Contact: beryllium copper, for 1Z1	8834416-1	94390
Pt. of 3C35	Insulator: teflon coated glass fabric, 1 3/16" x 1 3/16" x .010" thick	8834415-1	94389
	Washer, spring, 7/8" OD x 21/32" ID x 0.025" thick beryllium copper, tuning core tension	8831068-2	95394
	Nut, hex, brass 5/8-24 thread, tuning core locking	874927-6	95395
	Miscellaneous		
	Connector, male, coaxial, cable mtg.	8898625-501	54392
	Screw, thumb #10-32 thread, back panel holding	8886111-2	94391
	Shield, tube, 7 pin min., 1 3/8" lg.	99369-1	53016
	Shield, tube, 7 pin min., 1 3/4" lg.	99369-2	54521
	Shield, tube, 9 pin min., 1 13/16" lg.	8858642-3	56359



1 ALL CAPACITOR VALUES GIVEN IN UUF & ALL RESISTOR VALUES GIVEN IN OHMS AT ½W UNLESS OTHERWISE SPECIFIED

C-751277-5

Figure AFC-5—Terminal AFC Unit, MI-31492-C—Schematic Diagram



NOTES:

1. NUMBERS IN WIRES ARE WIRE NUMBERS (SEE TABLE)
2. WIRES IN CABLES HAVE WIRE NUMBERS AND DESTINATIONS AT EACH END.
3. WHERE A TINNED COPPER WIRE PASSES THRU A SOLDER LUG A HEAVY DOT INDICATES THAT IT SHOULD BE SOLDERED TO THE LUG.
4. SOLDER ALL ELECTRICAL CONNECTIONS USING PT 50.
5. SOLDER LUGS ON COILS ARE DELINEATED FOR CONVENIENCE IN SHOWING CONNECTIONS

WIRE TABLE		88 34 402-504		
WIRE NO (INCLUSIVE)	DESCRIPTION COLOR AND CONDUCTOR	PS NUMBER OR DRAWING NO.	PARTS LIST ITEM NO.	WIRE NOS NOT USED
1 TO 7	WHT-BRN 10/.010	PS-805-8	57	
13 TO 16	WHT-RED 10/.010	PS-805-8	58	
21	WHT-RED 7/.010	PS-805-6	61	
24	WHT-YEL/BLK 7/.010	PS-805-6	60	
27	WHT 7/.010	PS-805-6	59	
30	BRAID CABLE #2 STRAND .005 DIA	PS-499-53	55	
33 TO 46	TINNED COPPER WIRE .032D.	PS-105	51	
51 TO 66	BLACK INS. TUBING .042D.	PS-8	56	

D-636612-1

Figure AFC-6—Terminal AFC Unit, MI-31492-C—Connection Diagram

MICROWAVE COMMUNICATION EQUIPMENT

Receiver / Modulator MI-31102-B

- TECHNICAL DATA
- DESCRIPTION
- MAINTENANCE
- REPLACEMENT PARTS

RADIO CORPORATION OF AMERICA
COMMERCIAL ELECTRONIC PRODUCTS, CAMDEN, N. J.

PRINTED IN U. S. A.
517

IB-33227-2

Approved For Release 2001/03/04 : CIA-RDP79T01049A002600030004-6

TECHNICAL DATA

Power Input:
a. Filament Heaters: 35 watts at 115 v, 50/60 cycle ac
b. Plate Supply: 130 milliamps at 250 v dc

Frequency Range
2450-2700 megacycles

Receiver Band Width
6 megacycles

Receiver Noise Figure
12 db

I.F. Frequency
30 mc

R.F. Input Impedance
50 ohms

Carrier Operated Relay Sensitivity
C/N = 12 db max.

Baseband Output for ±1.5 mc Peak Deviation
1.2 v rms

Baseband Output Frequency Range
3 kc to 160 kc

Service Channel Output for ±75 kc Peak Deviation
7 v rms

Service Channel Frequency Response
300 cps to 3 kc ±2 db

Service Channel Signal-to-Noise Ratio
(below ±75 kc peak deviation)
35 db

Modulator Input for ±1.5 mc Peak Deviation
0.85 v

Relays

Symbol	*Function*
2K1	Receiver Fault
2K2	Noise Suppression
2K3	Standby Lockout/Loss-of-Signal Remote-Indication

Crystals

Symbol	*Type*	*Function*
2CR1	1N21B	RF Mixer
2CR2	CK705	RF Rectifier
2CR3	CK705	First Limiter
2CR4	CK705	First Limiter
2CR5	CK705	Second Limiter
2CR6	CK705	Second Limiter
2CR7	CK705	RF Rectifier

Tube Complement

Symbol	*Type*	*Function*
2V1	6CB6	First i-f Amplifier
2V2	6CB6	Second i-f Amplifier
2V3	6CB6	Third i-f Amplifier
2V4	6CB6	Fourth i-f Amplifier
2V5	6CB6	Fifth i-f Amplifier
2V6	6CB6	Sixth i-f Amplifier
2V7	6CB6	First Limiter
2V8	6CB6	Second Limiter
2V9	6AL5	Discriminator
2V10	6AS6	Modulator Mixer
2V11	6CB6	70 MC Amplifier
2V12	6AH6	FM Modulator
2V13	12AT7	40 MC Oscillator
2V14	12AT7	Fault Oscillator
2V15	6CB6	Baseband Amplifier
2V16	12AT7	Service Channel Amplifier
2V17	12AX7	Lockout Amplifier
2V18	12AT7	Lockout Amplifier

Weight and Dimensions

Weight—15 lbs.
Height—8¾"
Depth back of panel: 2⅞"
Depth front of panel: 4"
Width: 19" Rack Mounting

DESCRIPTION

The Receiver/Modulator is designed for mounting in either a standard 19" open rack or cabinet and is used in both terminal and repeater stations. The unit has two main functions. The receiver section amplifies and demodulates the incoming f-m signal from a terminal or repeater station and delivers the .3 to 160 kc information to the baseband and/or service units. The modulator section provides the transmitter with a 70 mc f-m carrier, modulated with the .3 to 160 kc multiplex and service channel signals. In a receiver at a repeater station the modulation on this 70 mc carrier also includes the incoming modulation on the 30 mc i-f signal.

Receiver

In the receiving section the incoming microwave signal is first converted to a 30 mc i-f. This is accomplished by mixing the microwave signal with a sample of the transmitter local oscillator frequency. These two frequencies are always 30 mc apart in accordance with the system plan. Refer to the system instructions for Typical Systems Frequencies. This mixing is done in mixer cavity 2Z1 which receives the microwave signal through a coaxial cable from the receiving filter unit. This cable is connected to cavity terminal 2J1 on the back of the chassis. A sample of the transmitter local oscillator frequency is fed by means of a

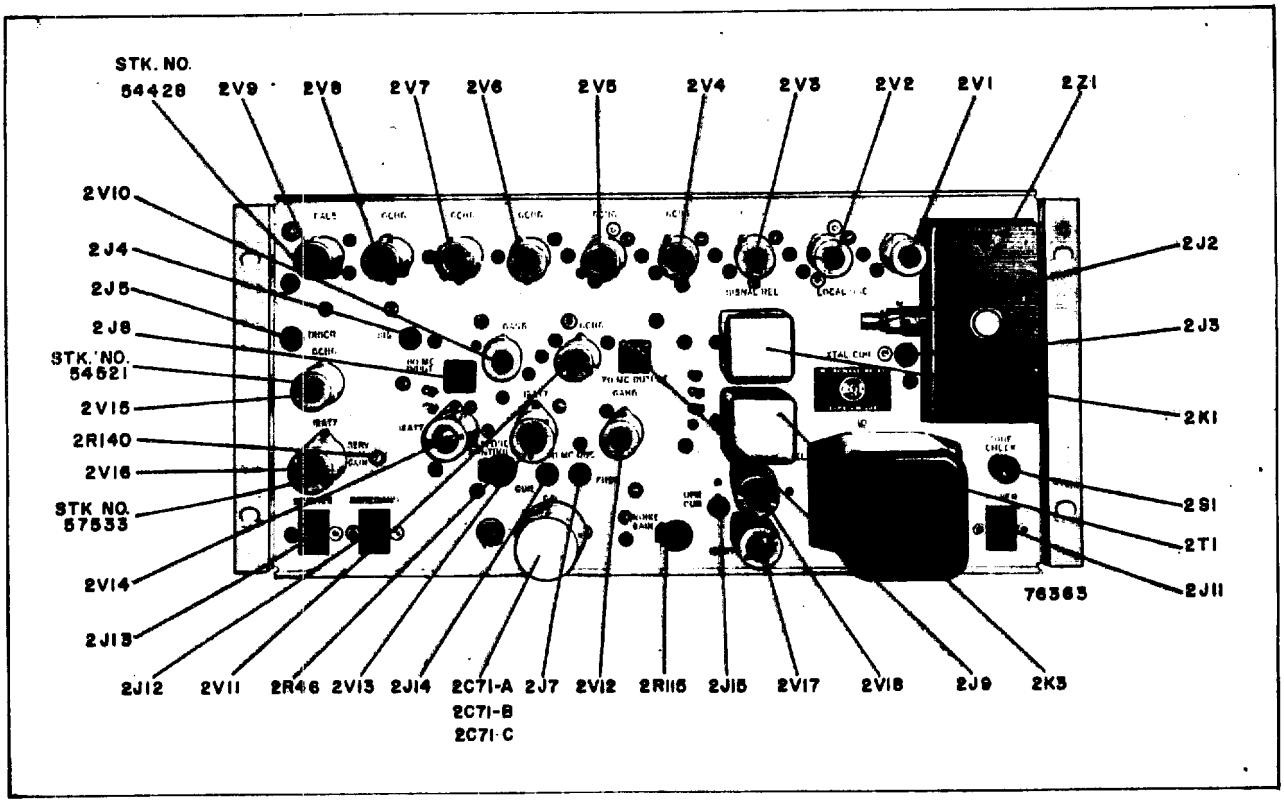


Figure RM-1—Receiver/Modulator—Front View

coaxial cable from terminal 1J1 of the transmitter to terminal 2J2, labeled LOCAL OSC., of the mixer cavity 2Z1. The difference frequency is generated by the mixer cavity crystal 1N21B and delivered to the grid of the first 30 mc i-f stage. The screwdriver adjusting control on the front of 2Z1 resonates the cavity to the correct frequency. Coupling loop 2J2 couples the local oscillator energy into the mixer cavity. The 30 mc output of cavity 2Z1 is amplified by 6 stages (2V1 thru 2V6) of i-f amplifiers to a sufficiently high level so that proper limiting action can take place in the two limiting stages 2V7 and 2V8. Each of the two limiting stages contain dual limiting circuits. Besides the limiting that occurs in the electron tubes, additional limiting action is performed in the circuits containing crystals 2CR3 and 2CR4 of the 1st limiter stage and crystals 2CR5 and 2CR6 of the 2nd limiter stage. The 30 mc output of the 2nd limiter stage is fed to discriminator 2V9 where the f-m signal is demodulated and the 300 cycle to 160 kc component delivered to baseband amplifier 2V15. The output of 2V15 is delivered to the baseband unit through 2J12-5 at all terminal and drop repeater stations. A portion of the output of 2V15 is applied to service channel amplifier 2V16. At stations using a Repeater Service Unit MI-31495 or Terminal Service Unit MI-31496 the output of 2V16 is supplied directly to the service unit through 2J13-2. At terminal and drop repeater stations using the indicon service channel system, signals to Service Channel Unit MI-31140 are supplied by the baseband unit through 4J3-5. At thru repeater stations using the indicon service channel system the output of 2V16 is supplied to Service Channel Unit MI-31140 through 2J12-5. A connection to terminal 1 of jack 2J13 from the discriminator output provides the dc amplifier of the transmitter AFC circuit with the dc correction voltage when the transmitter local oscillator drifts off frequency.

Modulator

In the modulator section, mixer 2V10 produces the 70 mc i-f signal which modulates the transmitter microwave carrier. Amplifier 2V11 amplifies the 70 mc i-f output of the modulator i-f mixer which is then coupled by coaxial cable to the transmitter by means of 70 MC OUTPUT jack 2J9. The source of the two signals that supply modulator i-f mixer 2V10 with its heterodyning frequencies differ for each type of station as follows:

a. At a terminal station the 70 mc subcarrier output of the modulator i-f mixer 2V10 is the difference frequency of a 110 mc and a 40 mc signal. The 40 mc signal is the output of oscillator 2V13 and contains the multiplex and service channel signals from the baseband unit. The 110 mc frequency is received from the terminal AFC and is coupled through a coaxial cable to the 110 MC INPUT jack 2J8 of the receiver/modulator. At terminal stations only, internal bus connection "P" must be made to jack 2J8, connection "O" made at jack 2J12, coil 2L47 shorted, and connection "L" omitted. (The letters "P", "O" and "L" refer to connections found on the receiver/modulator schematic of figure RM-11.) Adding connection "P" feeds the 110 mc frequency from the terminal AFC unit to the modulator i-f mixer 2V10. Removing connection "L" disconnects the receiver 30 mc signal from 2V10. Shorting 2L47 prevents 2V14 from operating as a 110 mc oscillator. Adding connection "O" maintains the proper baseband output load impedance when only one receiver/modulator unit is used as at a terminal station. The amount of baseband signal applied to 2V12 is determined by the setting of Modulator Gain control 2R109 which is adjusted at the factory so that the modulation sensitivity of all receiver/modulator units will be the same.

b. At drop repeater stations the 70 mc subcarrier output of the modulator i-f mixer 2V10 is the sum frequency of a 30 mc and a 40 mc signal. The signal from the 40 mc oscillator 2V13 and frequency modulator 2V12 contains the 300 cycle to 160 kc multiplex and service channel frequencies added at this station. The 30 mc signal comes from the receiver 1st limiter stage output and contains the intelligence modulated on the received microwave signal.

c. The modulator section of a thru repeater station is the same as that of a drop repeater station except the 40 mc oscillator signal to the modulator-mixer stage 2V10 contain only 300 cycles to 3 kc service channel information (voice communication and fault tone pulses) from the service unit.

In repeater stations the 30 mc frequency to the modulator mixer stage 2V10 comes from the 1st

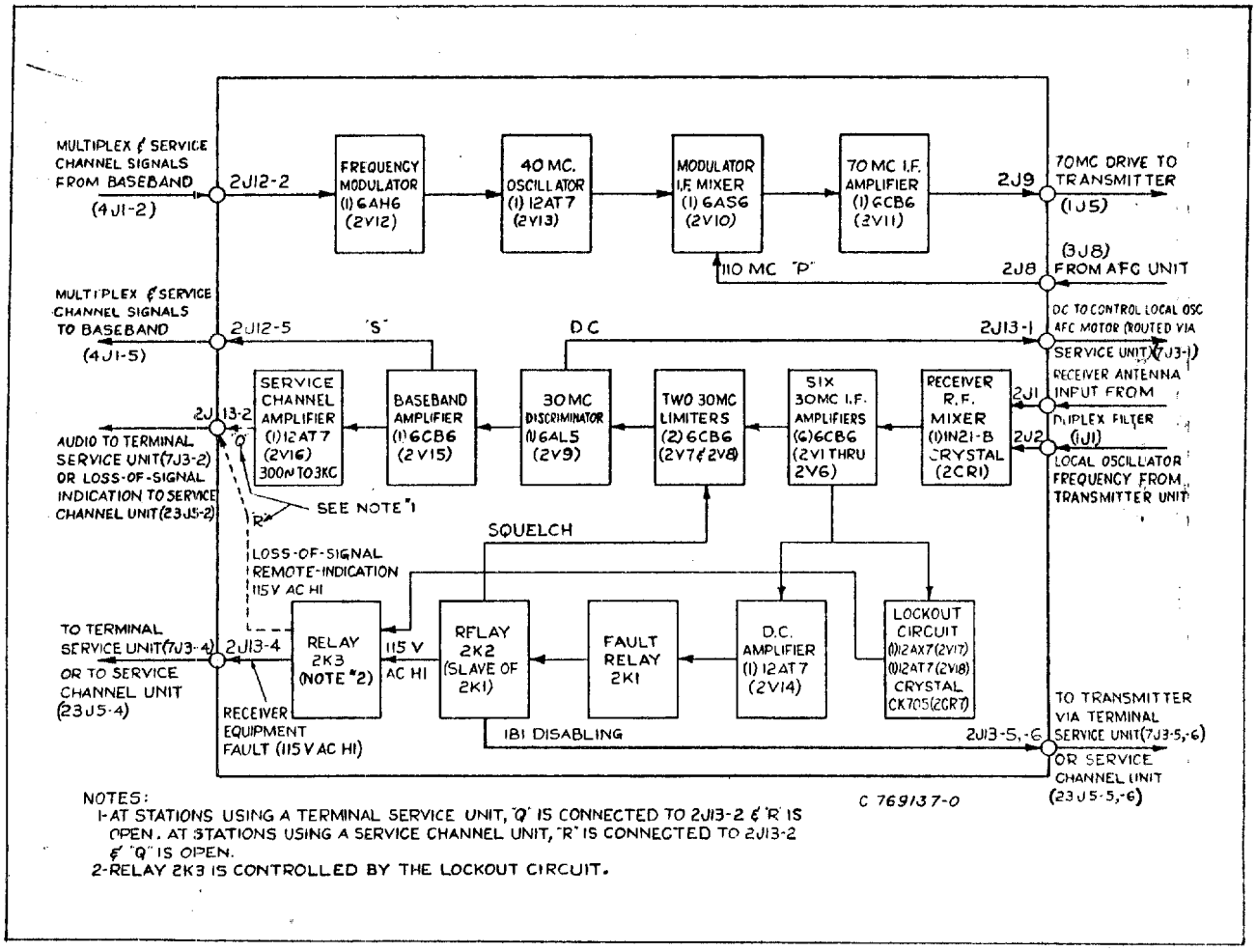


Figure RM-2—Receiver/Modulator—Block Diagram—Terminal Station

limiter (2V7) output circuit. Be certain that internal connection "L" is made when the receiver/-modulator is used in either a drop repeater or a thru repeater station and removed when used at a terminal station.

Operation of Relays 2K1, 2K2 and 2K3

If the i-f amplifier strip fails to function or the incoming signal fades below threshold or is lost completely, the positive d-c voltage (from crystal 2CR2 of the 6th receiver i-f stage) normally present at pin 2 of 2V14 is greatly reduced, causing the 6-7-8 section to 2V14 to conduct.

At a drop or thru repeater station the 6-7-8 section of 2V14 is a 110 mc oscillator which supplies one of the two heterodyning frequencies to 2V10. The 110 mc frequency is heterodyned with the 40 mc oscillator output providing a 70 mc frequency (110 mc – 40 mc) to keep the transmitter radiating a quieted carrier. Relay 2K1 in the plate circuit of the 6-7-8 section of 2V14 is energized when 2V14 starts oscillating.

At a terminal station the 110 mc output of 2V14 is not required. Tube 2V14 is changed to a d-c amplifier by shorting out plate coil 2L47. When 2V14 is operated by an i-f failure or loss-of-signal, relay 2K1 is energized.

Relay 2K1 Operation

Contact 3-4 closes, energizing relay 2K2.

Relay 2K2 Operation

1. Contact 2-4 opens, breaking the B+ circuit to limiters 2V7 and 2V8.

2. Contact 2-3 closes, grounding the plate and screen circuits of limiters 2V7 and 2V8. This, in conjunction with the action of contact 2-4, disables limiters 2V7 and 2V8. With no input to discriminator 2V9 and mixer 2V10, any noise voltage

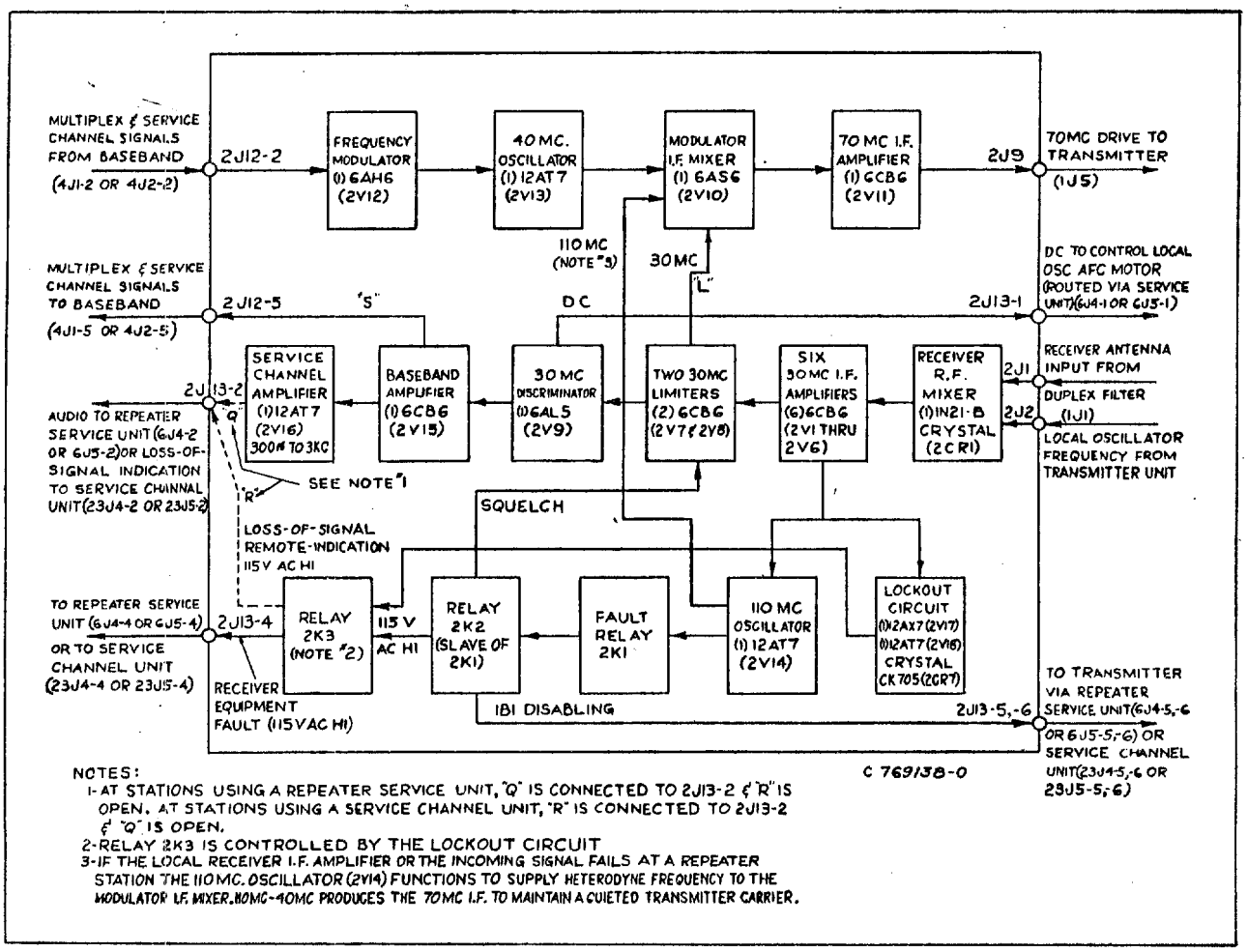


Figure RM-3—Receiver/Modulator—Block Diagram—Drop Repeater Station

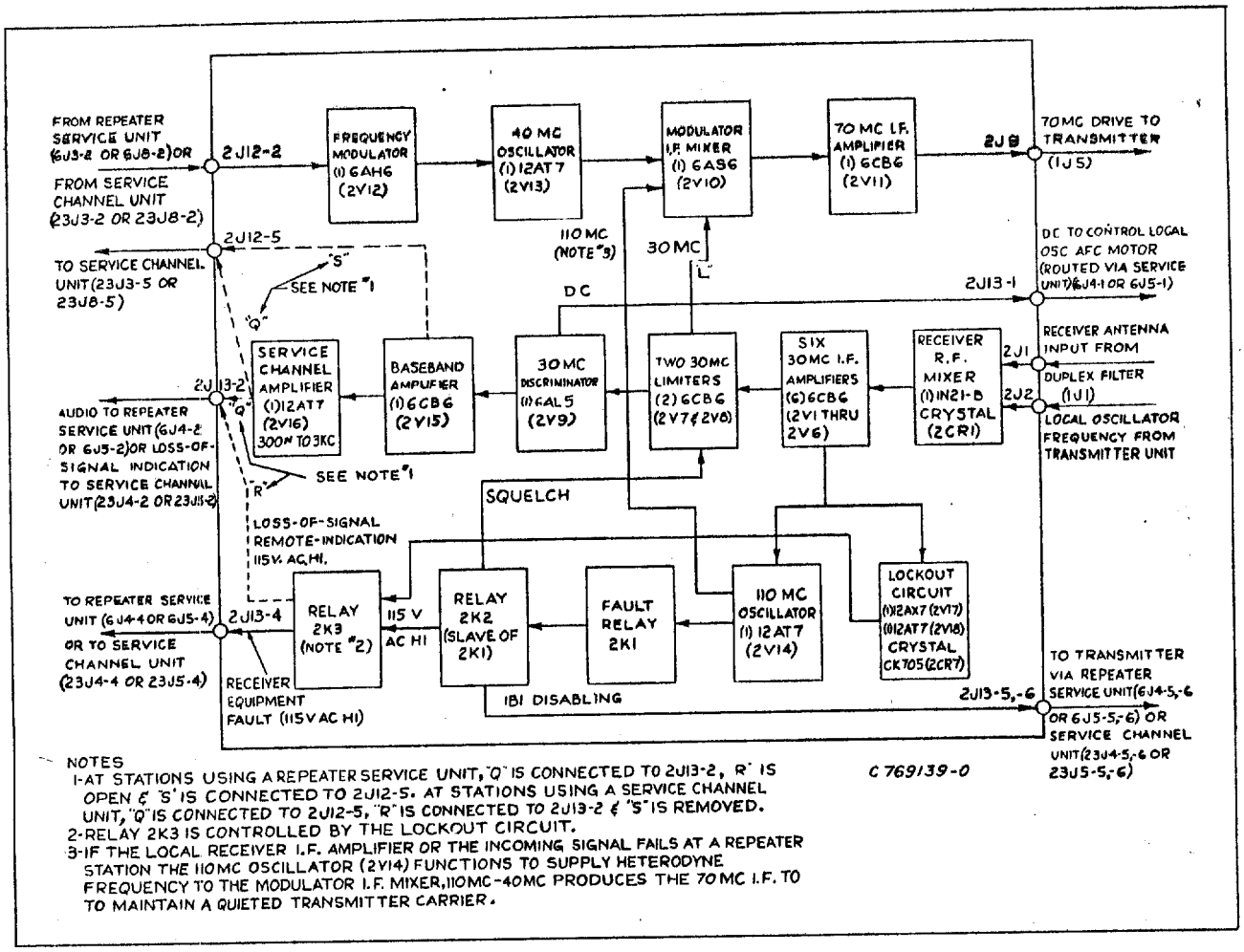


Figure RM-4—Receiver/Modulator—Block Diagram—Thru Repeater Station

present in the i-f amplifier is prevented from reaching the multiplex equipment and service units and from being transmitted.

3. Contact 5-7 opens. This breaks the 115 v ac supply to AFC motor 1B1 in the transmitter, disabling it for the duration of the operation of relay 2K2.

4. Contact 6-7 closes and connects one side of the 115 v ac supply to terminal 3 of relay 2K3.

Relay 2K3 Operation (Lockout Circuit)

The lockout circuit consists of several stages of audio (noise voltage) amplification 2V17 (1-2-3), 2V17 (6-7-8) and 2V18 (1-2-3), a crystal rectifier 2CR7, a d-c amplifier 2V18 (6-7-8) and d-c relay 2K3. The action of the lockout circuit is controlled by the voltage present at the junction of resistors 2R21 and 2R127 or for reference purposes at the more easily identified SIG jack 2J4.

Receiver Equipment Fault

If the i-f amplifier fails to function normally, the d-c voltage present at 2J4 drops sufficiently to cause relay 2K1 to operate relay 2K2, closing contact 6-7. Any noise voltage present at 2J4 is too weak to activate the lockout circuit so relay contact 2-3 of relay 2K3 is closed (2K3 not operated). This condition completes the 115 v ac circuit to the fault reporting equipment and to the switching unit at stations that have standby facilities, thereby initiating the report of a receiver failure and at standby stations the switchover to the standby radio equipment.

Loss-of-Signal Remote-Indication

A loss-of-incoming-signal condition causes a decrease of the dc voltage at 2J4 sufficient to operate relays 2K1 and 2K2. It also causes an ac noise voltage at 2J4 which is impressed on 2V17-2, am-

plified through three audio stages, rectified by diode 2CR7 and impressed on the grid of d-c amplifier 2V17 (6-7-8). The resultant plate current flow operates lockout relay 2K3. Contact 2-3 breaks, opening the 115 v ac circuit to the switching unit at standby stations, thereby preventing switchover. Contact 3-4 closes, completing the 115 v ac circuit through 2J13-2 to Service Channel Unit MI-31140, Coder Unit MI-31138 or Decoder Unit MI-31139 thus reporting a loss-of-signal remote-indication. At standby and indicon service channel system stations tubes 2V17, 2V18 and relay 2K3 are always required. At non-standby stations using Repeater Service Unit MI-31495 or Terminal Service Unit MI-31496, tubes 2V17, 2V18 and relay 2K3 are omitted and connection "T" ties pins 2 and 3 of 2X19 together. This connection is necessary for the proper operation of the receiver equipment fault circuit at stations using MI-31495 or MI-31496.

CONTROLS

a. The Cavity Tuning control (2Z1) is used to tune the mixer cavity to the frequency of the incoming signal.

b. The REL. OSC. control (2R46) adjusts the grid bias of the dc amplifier section of 2V14 thereby controlling the condition under which the tube will conduct and 2K1 will operate.

c. The DISC pin jack (2J5) is used to connect test meter 1M1 to the output of the discriminator to determine if the i-f frequency is centered at 30 mc.

d. The SIG. pin jack (2J4) is used to connect the test meter 1M1 to measure the signal voltage of the i-f section when tuning the receiver.

e. The CUR. (2J14) pin jack is used to connect the test meter 1M1 when tuning the 40 mc f-m osc. of the modulator section.

f. The FREQ. (2J7) pin jack is used to connect the distortion and modulation test unit to the modulator while aligning the receiver.

g. The XTAL. CUR. pin jack (2J3) is used to connect the test meter 1M1 when adjusting 2J2 of the mixer cavity for proper crystal excitation.

h. The 110 MC INPUT (2J8) coaxial terminal is used to connect the 110 mc output of the terminal AFC unit to the receiver r-f mixer grid. It is used only at terminal stations.

i. The 70 MC OUTPUT coaxial terminal (2J9) is used to connect the 70 mc output of the modulator section to the transmitter 70 mc input.

j. The LOCAL OSC coaxial terminal (2J2) is the input terminal for connecting a portion of the output of the transmitter local oscillator to the mixer cavity.

k. The Receiver Baseband Gain control 2R107 is a screw driver adjusting potentiometer for regulating the signal voltage level from amplifier stage 2V15 to the baseband unit and to the signal channel amplifier stage 2V16. This control, located in the rear of the unit, is adjusted and sealed at the factory and normally requires no adjustment in the field.

l. The Modulator Gain control 2R109 is a screwdriver adjusting potentiometer for controlling the amount of signal voltage from the baseband unit applied to the 40 mc modulator stage 2V12. This control, located in the rear of the unit, is adjusted and sealed at the factory and normally requires no adjustment in the field.

m. The NOISE GAIN potentiometer 2R115 is a control for regulating the amount of noise signal to amplifier 2V17 (6-7-8).

n. The "OPR CUR" jack 2J15 is for monitoring the operating current of the dc amplifier 2V18 (6-7-8) when adjusting the noise gain control.

o. The TUBE CHECK pushbutton 2S1 is used to reduce the filament voltage of the tubes for the purpose of checking their operating condition.

p. The SERV CHAN GAIN control 2R140 is used to adjust the input to the service channel amplifier 2V16.

MAINTENANCE

General Notes

The majority of tubes in the receiver/modulator can be checked while the unit is in operation by use of TUBE CHECK pushbutton 2S1. With the unit operating normally connect SIG jack 2J4 to test meter 1M1 and note the current reading. If this reading drops more than 50% when 2S1 is depressed there is a near-failure tube probable in one of the first five 30 mc i-f sockets (2V1 thru 2V5). If the current read at the 40 mc OSC CUR jack drops more than 20% with 2S1 depressed it is probable that either 2V12 or 2V13 are near failure. If this check is satisfactory, a check of 2V10 and 2V11 is possible by observing the rf monitor meter 1M2 reading. If its reading drops more than 60% a near-failure tube is probable in sockets 2V10 or 2V11. A check of 2V6 thru 2V9 and 2V15 is possible by monitoring a received

multiplex signal. If the level of this signal varies more than ±2 db a probable near-failure tube exists in one of these sockets.

Regarding changing tubes in the receiver/modulator it should be cautioned that certain tubes should be replaced only if absolutely necessary. 2V8 (2nd Lim.), 2V9 (Discr.), 2V12 (Mod.), and 2V13 (Osc.) have effects upon the modulation and demodulation linearity of the system. As a consequence these should not be changed unless complete tube failure makes it necessary.

The changing of these tubes may affect the linearity of these stages. Do not attempt a linearity realignment unless the cross talk between channels is noticed to increase intolerably. See the CIRCUIT ALIGNMENT section following, if linearity alignment is required.

If either 2V12 or 2V13 are changed, the frequency of the 2V13 oscillator should be adjusted to 40 mc by varying 2L57 "40 MC OSC" only. When measuring the frequency of the 40 mc oscillator there must be no modulation on it. To make sure there is no hum input, pull out the baseband plug feeding the receiver/modulator during the measurement. If 2V14 is changed the frequency and operating point of the 110 mc oscillator will need to be rest.

The information required for checking and adjusting the frequency of the 40 mc and 110 mc oscillators will be found in the INITIAL ADJUSTMENT procedure of the system instructions and the CIRCUIT ALIGNMENT section following.

When *replacing a 1N21B Crystal,* caution must be exercised to prevent damaging the crystal by static discharge. To prevent this, one hand should be grounded to the chassis before the crystal is allowed to touch any part of the equipment. A soldering iron should never be used on circuits connected to the 1N21B crystal without unplugging the iron for the period of use. AC leakage current may otherwise burn out the crystal. The 1N21B crystal current should never be allowed to exceed a meter reading at 2J3 of 200 μa.

If a tuning coil in the 30 mc i-f or 70 mc i-f circuits should open or become damaged, install a replacement coil with its core turned in the same amount as in the faulty coil. When thus repaired these circuits will be adequately well aligned.

Tuning coils of the frequency modulator stages 2V12 or 2V13 and discriminator stage 2V9 cannot be replaced without alignment of those circuits.

The plug-in electrolytic capacitor 2C71 should be replaced after being in use continuously for one year.

The schematic of figure RM-11 shows the dc voltage values at all pertinent circuit check points. Certain of these points contain double voltage readings. Wherever these readings occur, except for standby lockout circuit 2V18, the value above the line is the voltage with no signal at the receiver input and the value below the line is present with a saturating signal. For 2V18 the upper value is for little or no signal and the lower value is with tube 2V1 removed.

CIRCUIT ALIGNMENT

The following instructions describe the process for complete realignment of a receiver/modulator unit. It is strongly cautioned that before such a realignment be attempted full familiarity with the unit be obtained and all of the recommended test equipment listed in the test equipment tables of the system instructions be assembled.

The test items specified in the following alignment procedures refer to the test equipment items listed in the test equipment tables of the system instructions.

Limiter Alignment

a. Remove 2CR1. Attach the sweep generator output to the junction of 2C42 and 2C45; attach the scope lead to the junction of 2L40 and 2R37; attach test equipment item 27(a) between ground and 2C139. Set the sweep generator output low enough so that the stage has not started to limit and the scope response is sharp. Peak 2L35 at 30.0 mc.

NOTE: In this and other applications, use a 10 microhenry r-f choke with leads approximately one inch long (test item 27(d)) in series with the scope lead.

b. Repeat the above, peaking 2L31 with the sweep generator attached to the high side of 2L27 and the scope attached to 2V7-6. Remove test equipment item 27(a).

30 MC IF Alignment

a. Remove the rubber base cement used to prevent the cores of the i-f transformers from moving. Use a sharp instrument to loosen the edge of the seal and then peel off the cement.

b. Apply the output of the 30 mc sweep generator to the bottom end of 2L22, ground pin 1 of 2V4 to the center pin of the socket with a test prod, and attach the scope to the junction of 2C37 and 2R21. Adjust the output of the sweep generator for

approximately +0.2 v dc at 2R21 with the "sweep" knob in the "narrow" position. Turn on the sweep generator markers at 25.6 mc and 34.4 mc. With the "sweep" knob in the "wide" position, align the stage for symmetrical response, (stages will vary from critical coupled to somewhat less than critical coupled) and for band-width such that the two markers fall on the 50% response point. It will be found that 2L25 and 2L27 act much the same as the primary and secondary respectively of a double-tuned circuit. 2L26 controls the primary-to-secondary coupling and consequently the stage bandwidth.

NOTE: Solder a 100 K ohm isolation resistor in series with the Voltohmyst test probe.

c. Connect the sweep generator to 2L17, ground 2V3-1, connect test equipment item 27(c) (see figure RM-6) to the bottom end of 2C27, and attach the scope to the alignment jig. With the scope gain on maximum, adjust the sweep generator output for the minimum value providing an adequate picture. Align 2L20, 21 and 22 as above except place the 25.6 mc marker at the 60% response point and the 34.4 mc marker at the 40% response point as shown in figure RM-5.

This is done so that when the slight capacity added by the alignment jig is removed, the stage will be properly centered around 30 mc.

d. Apply the sweep generator to 2L12, ground 2V2-1, attach the alignment jig to the bottom of 2C21, and apply capacitor test equipment item 27(e), to 2V5-5 so as to ground this point to r-f only. Align 2L15, 16 and 17 as in (c).

e. Align 2L10, 11 and 12 as in (d) by moving all test equipment items forward one stage.

f. Attach the 680-ohm - 47 ohm resistor combination, test equipment item 27 (b) (see figure RM-8), between the screw directly above 2L3 and the standoff insulator connection to 2L1.

Align 2L5, 6 and 7 as in (d) by moving all test equipment items forward one stage except apply sweep generator through a 1500 mmf ceramic capacitor to 2V1-1.

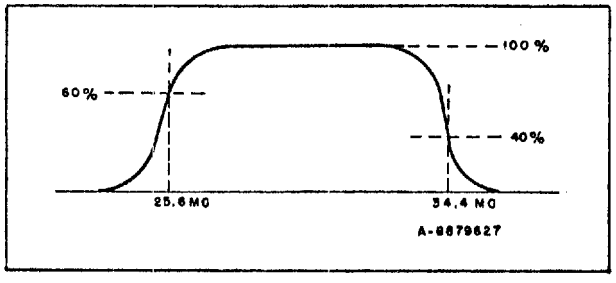


Figure RM-5—30 mc IF Response Curve

g. Attach the sweep generator to the high side of the 47 ohm resistor, the scope to the junction of 2L3 and 2R86 and r-f ground 2V2-5. Align 2L1, 2 and 3 for a flat-topped response regardless of the stage bandwidth unless this bandwidth is less than 8.8 mc. In this latter case align for 8.8 mc bandwidth.

Since the alignment jig is not used in this case the stage is to be aligned symmetrically about 30 mc as in (b) with the two markers at the same percentage response.

Remove test equipment item 27(b).

h. To insure that the limiter interstages are acting as limiters, connect the sweep generator to 2L22, the scope to the junction of 2L40 and 2R37, and test equipment item 27(a) to 2C139. Starting with a low enough sweep generator output so that the picture viewed is a sharply peaked response, increase the output and observe that the response broadens out and reaches a limiting value. Repeat with the scope on 2V7-6.

NOTES: 1. To minimize spurious interstage coupling, the ground return connection of the sweep generator should always be kept to the left of the point at which the sweep generator is being applied (as viewed from the rear of the chassis).

2. The sweep generator output cable is to be terminated in 68 ohms at the cable end. The leads from the end of the cable to the point of use should be kept as short as possible—certainly under 2".

3. To obtain an i-f response centered around 30 mc, it may be necessary to slightly favor either band edge marker at the expense of the other. Depending upon how well the results of test (b) (IF Response Check) indicate i-f symmetry, a touch method for tuning the i-f's a bit high or low may need to be used.

R-F Test and I-F Gain Check

Insert 1N21B crystal.

CAUTION: Ground the body to the receiver chassis before inserting the crystal to prevent static discharge from damaging the crystal.

a. Apply the transmitter local oscillator frequency to 2J2. Adjust the position of 2J2 for 2J3I = 50μa. With no input signal to the i-f or r-f note the value of 2J4E due to amplified noise. If this reading is below 0.1 volt, the i-f has insufficient gain and the quality of the i-f tubes should be investigated. The 0.1 volt reading is equivalent to a reading of 5 μa using the 200 μa test meter.

b. Maintaining the local oscillator feed at 2J3I = 50 μa attach test equipment item 16, the

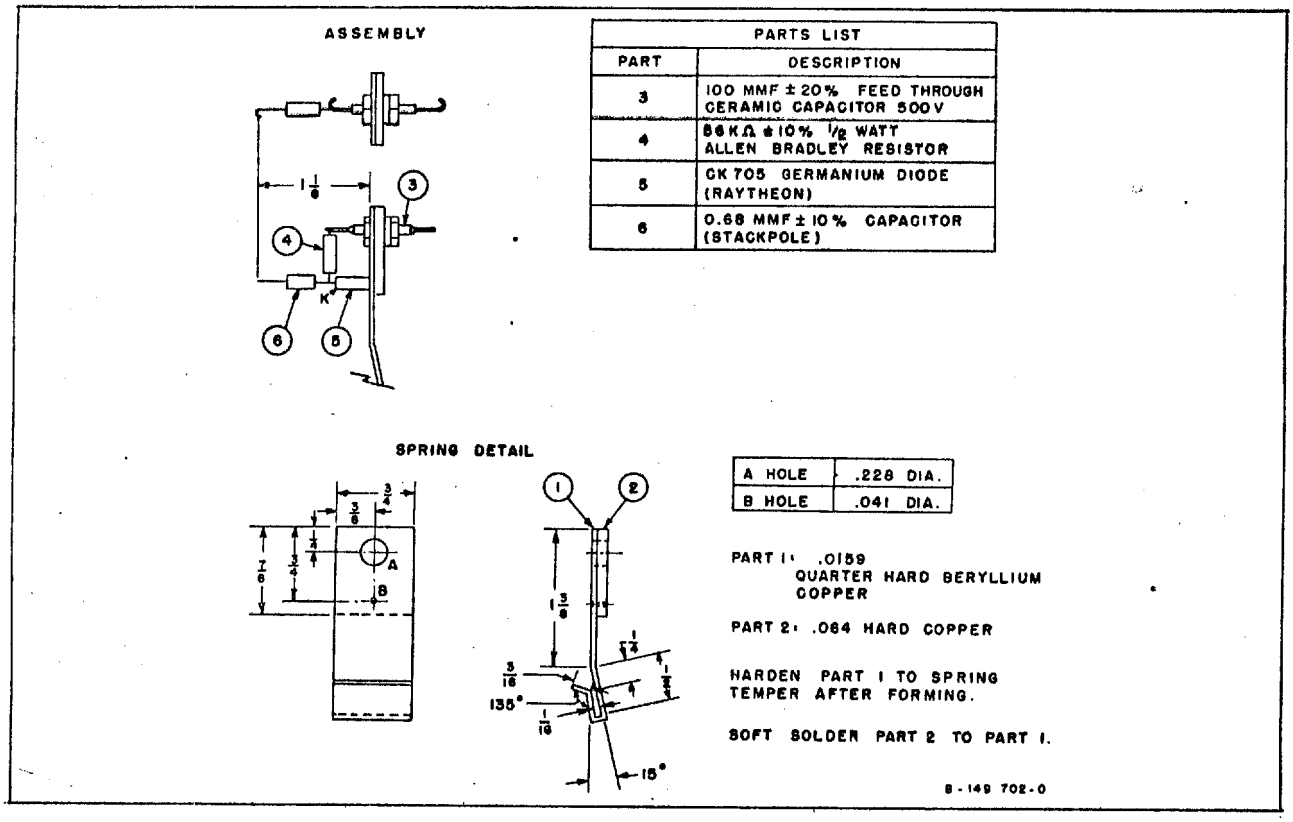


Figure RM-6—30 mc IF Alignment Jig

r-f signal generator. Note the reading of 2J4E on noise with the signal generator off. Turn on the signal generator and adjust its frequency to that normally received. Fine tuning is accomplished by tuning for zero discriminator current (2J5). Increase the 2J4E reading by the noise figure factor listed below (depending upon the original noise reading).

2J4E on Noise	*Noise Figure Factor*
.05 v to 0.1 v	1.6 x
0.1 v to 0.4 v	1.5 x
0.4 v to 0.8 v	1.4 x

Note the signal generator reading in microvolts. It should be equal to or less than 4.2 μv. This figure corresponds to a noise figure of 12.0 db.

NOTE: For all of these tests a short, low loss r-f cable must be used to connect the r-f test equipment to the receiver.

I-F Response Check

a. Calibrate the discriminator (with the i-f cover on) by applying high level, saturating signals to the i-f at 28, 30 and 32 mc, recording the discriminator voltage for those frequencies.

Connect the r-f signal generator to 2J1 and apply a signal at the frequency of the assigned received signal. Adjust its exact frequency so that the i-f frequency is 30.0 (0 current at 2J5) mc and adjust the level for 2J4E = 1.0 v. Adjust the slug of 2Z1 for a peak reading. Vary the signal generator frequency (keeping its output constant) and note 2J4E for i-f signals of 28.0 mc and 32.0 mc. The i-f response in db, defined as

$$20 \log_{10} \frac{E(28 \text{ mc or } 32 \text{ mc})}{E(30 \text{ mc})}$$

should not vary from the 30 mc value by more than ±1.5 db.

NOTE: In this case and others when a saturating 30 mc i-f signal is desired, the maximum output of the i-f signal generator will suffice. It should be fed into the i-f strip through the hole in the cover just above the hole for the tuning slug of 2L2.

70 mc I-F Alignment

a. Connect the "70 MC OUTPUT" of the receiver/modulator to the 70 mc jack of test equipment item 27(f) (see figure RM-7) using the 70 mc coaxial cable that is normally connected to the Transmitter "70 MC INPUT." (No other cable

should be used.) Attach the scope to the "d-c" pin of test item 27(f) (70 mc dummy load) and the sweep generator, with 70 mc sweep at full output, to 2V11-1. Align the output network, by tuning 2L55 and 2L56 so that the response is symmetrical and the 64 mc and 76 mc pips fall at the 70% response point.

b. Connect the sweep generator to the hot end of 2L50. With the scope still on "d-c", reduce the output of the sweep generator until the observed scope picture height is roughly the same as it was in (a). Connect the scope to 2V11-6. Align 2L52, 53 and 54 as above for symmetrical response and for pips at the 70% response points.

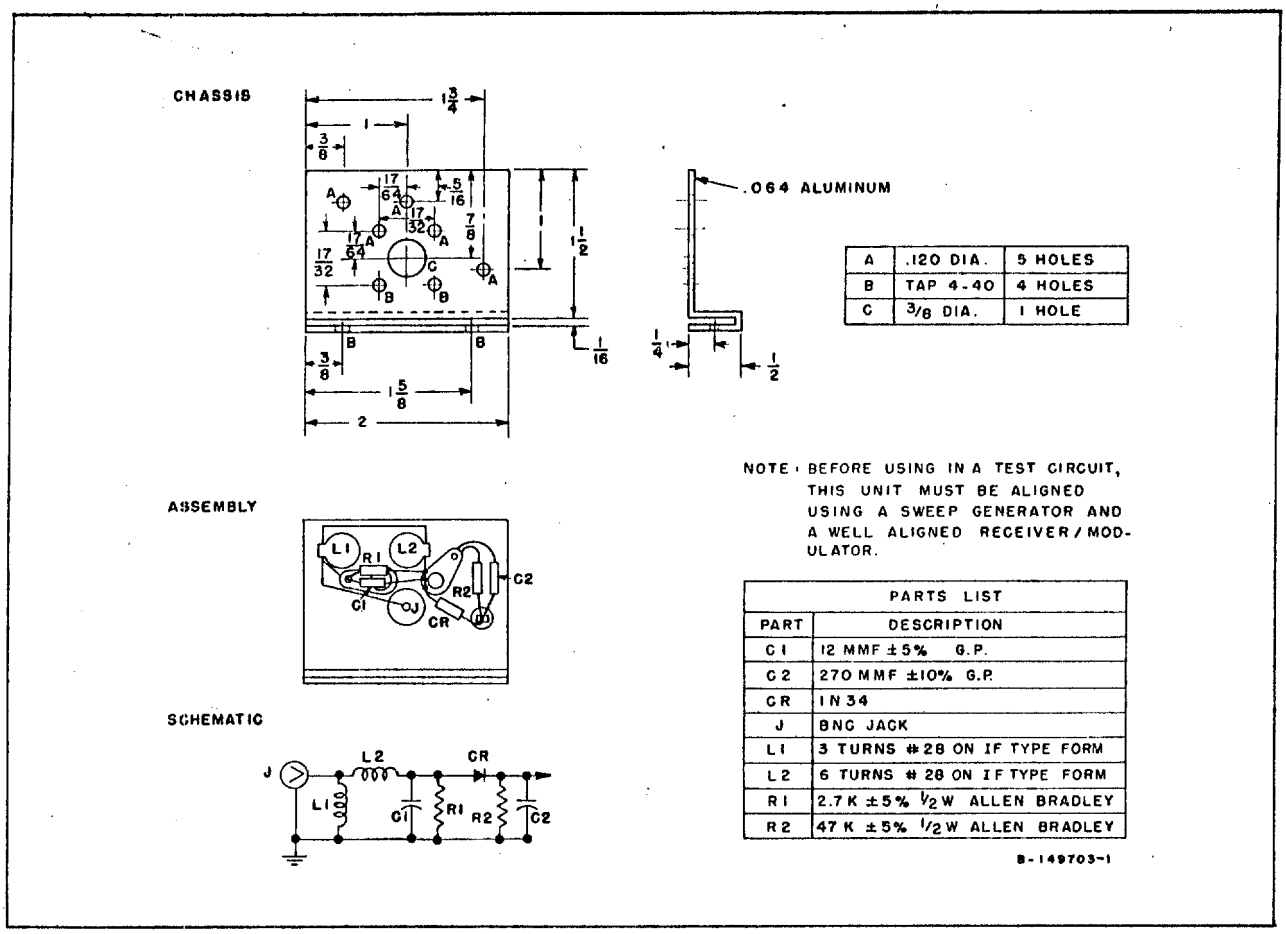
Mixer Circuit Alignment

Using the megacycle meter (test equipment item 12) adjust the 40 mc oscillator (2V13) so that its frequency is 40.0 mc. Make sure that 2J14I (as measured with the 200 μa meter, test item 14) is reading a reasonable value—between +65 μa and +80 μa. Apply a 30.0 mc saturating signal to the 30 mc i-f. Metering the voltage at the "d-c" terminal of 70 mc dummy load, peak 2L49 and 2L50. This must be done very carefully since the maxima are quite broad. The rectified dummy load dc voltage should be 1.5 volts or greater. *Wire "L" must be connected for this test.*

Fault Oscillator/Relay Adjustment

a. Turn 2R46 maximum clockwise to insure strong oscillation of 2V14. Using the megacycle meter (test item 12) set the oscillator frequency to 110 mc. The rectified dummy load dc voltage should be 1.5 volts or greater.

b. To adjust the REL/OSC CONTROL 2R46 connect the r-f signal generator (test item 16) to 2J1. With the signal generator at zero output, plug the 1M1 meter lead into the SIG jack and note the noise reading on the test meter. Turn up the signal generator output until a reading of 20 μa plus the noise reading is obtained. Then turn the REL/OSC CONTROL fully clockwise and then carefully counter-clockwise, stopping when the



A	.120 DIA.	5 HOLES
B	TAP 4-40	4 HOLES
C	3/8 DIA.	1 HOLE

NOTE: BEFORE USING IN A TEST CIRCUIT, THIS UNIT MUST BE ALIGNED USING A SWEEP GENERATOR AND A WELL ALIGNED RECEIVER/MODULATOR.

PARTS LIST	
PART	DESCRIPTION
C1	12 MMF ±5% G.P.
C2	270 MMF ±10% G.P.
CR	1N34
J	BNC JACK
L1	3 TURNS #28 ON IF TYPE FORM
L2	6 TURNS #28 ON IF TYPE FORM
R1	2.7K ±5% 1/2W ALLEN BRADLEY
R2	47K ±5% 1/2W ALLEN BRADLEY

B-149703-1

Figure RM-7—70 mc Dummy Load

relay clicks. The relay should now operate and the 110 mc oscillator become operative and inoperative as the signal is removed and reapplied.

Discriminator Alignment

a. *Remove wire "L."* Turn controls 2R107 and 2R109 on the receiver/modulator unit to maximum. Attach the distortion and modulation test unit, test equipment item 11, to the receiver/modulator, putting only the 30 mc probe and the 40 mc probe in place. With the "40 mc Var" oscillator, and "40 mc Xtal" oscillator on, locate the beat between the two with the "40 mc Var" control. Note dial reading. With "40 mc Xtal" oscillator off, adjust 2L57 until the 2V13 oscillator beats with the "40 mc Var" oscillator. Turn off the "40 mc Var" oscillator.

NOTE: For all of this test the covers for both the 30 mc i-f and the oscillator-mixer section must be kept on.

b. Plug in the baseband connection. Apply the transmitter local oscillator frequency to 2J2. Adjust the position of 2J2 for 2J3I = 50 μa.

Each distortion and modulation test unit is factory adjusted so that its meter (M1) will read 100 for ±750 kc deviation when the meter is on the "35 mc Osc" position at which time it reads the tone level being supplied to the 35 mc modulator/oscillator. For an average modulator section (in the receiver/modulator unit) a reading of 60 will result in a ±750 kc deviation, with the meter switch on the "Rec-Mod" position.

Put the operation switch in the "Discr" position. With meter on "35 mc Osc." adjust Osc. B on 50 kc for a reading of 100. With the meter on "Rec. Mod." adjust Osc. A on 70 kc for a reading of 60. With the meter on 0 db and Osc. B changed to 30 kc, adjust "30 kc Gain" for full scale (0 db) reading. With Osc. A on the 70 kc and 80 kc positions, and Osc. B on 50 kc read the intermodulation products at 30 kc with the meter. In the 70 kc and 80 kc positions the unit is measuring the products due to third and second order intermodulation respectively. Adjust the discriminator so that both 70 kc and 80 kc products are minimum. It should be possible to align the units so these products are below –43 db, however a value of –40 db will provide satisfactory service.

In aligning the discriminator it will be found that 2L41 primarily adjusts the high frequency peak and 2L42 primarily adjusts the low frequency peak. The 70 kc product is determined by the separation of these two peaks and the 80 kc product is determined primarily by the 2L40 tuning.

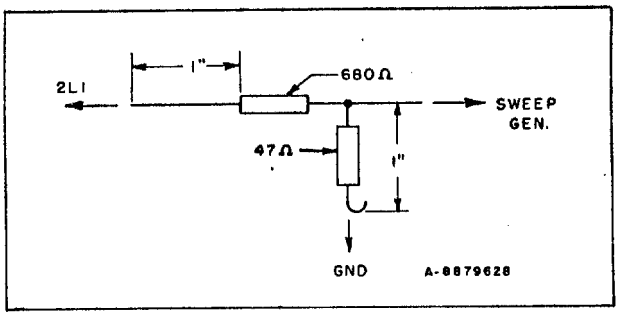


Figure RM-8—30 mc Alignment Resistor Network

During this and the remaining intermodulation tests, the discriminator (2J5) reading must be kept on zero (±0.1 v) by varying the frequency of the test unit 35 mc oscillator after first ascertaining that the 40 mc oscillator is on frequency. Also, in tuning the discriminator the condition shall be maintained that: *the discriminator d-c output for a saturating CW signal of 30.0 mc must be zero volt ±0.1 v.*

c. Test the discriminator linearity at half deviation using essentially the same procedure as above, except use readings of ½ the above for the oscillator levels. (Readjust the "30 kc Gain" for full scale reading in this revised condition.) It should be possible to align the units so that in this case the products will be below –51 db, however, a value of –45 db will provide satisfactory service.

Modulator Alignment

a. Continuing with the test unit, change to the "overall" test position. With the meter on "Rec Mod", "Osc. A" off and "Osc. B" on 50 kc adjust the output of "Osc. B" to 60. With "Osc. B" off and "Osc. A" on 70 kc adjust its output to 60. With both oscillators on and Osc. B on 30 kc, adjust "30 kc Gain" for full scale on meter "O db". With "Osc. A" on 80 kc, tune 2L58 for minimum meter reading. Check the meter reading with oscillator A on 70 kc. It should be possible to align the units so that these products are below –43 db, however a value of –40 db will provide satisfactory service.

b. Test the overall operation at half deviation using essentially the same procedure as above except using a meter reading of 30. (Readjust "30 kc Gain" for full scale.) It should be possible to align the units so that in this case the products will be below –51 db, however a value of –45 db will provide satisfactory service.

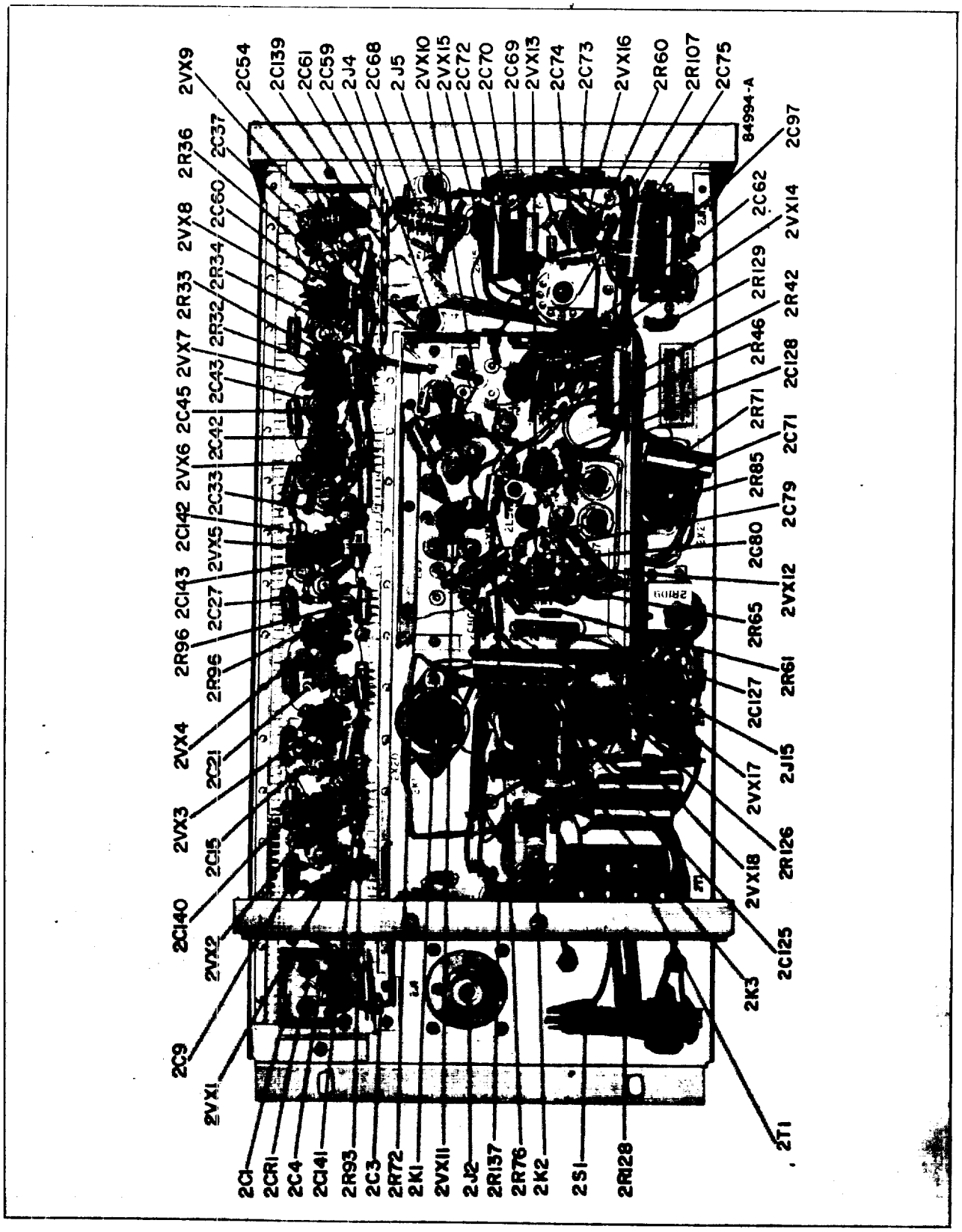


Figure RM-9—Receiver/Modulator—Rear View, Dust Cover and Shield Covers Removed

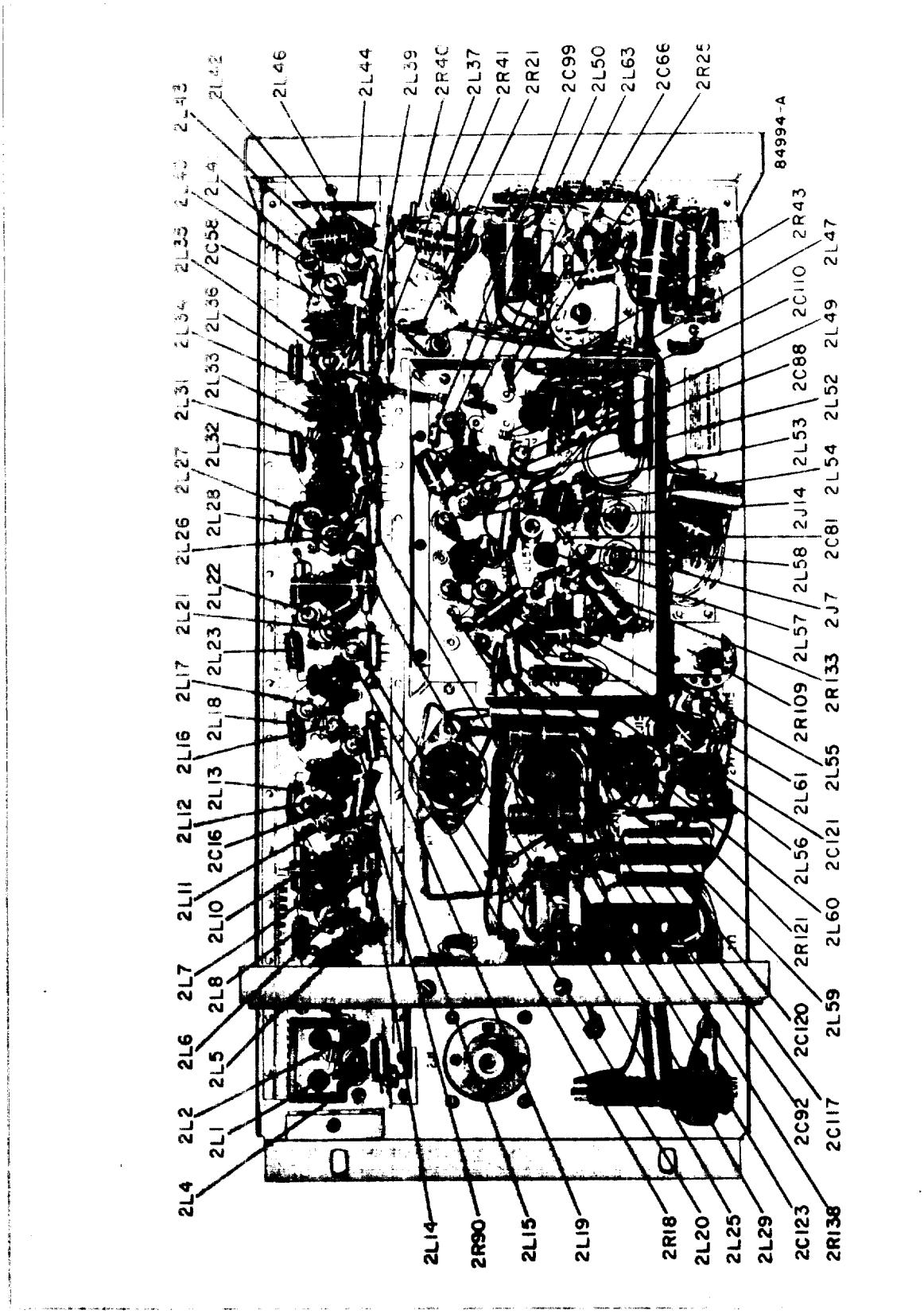


Figure RM-10.—Receiver/Modulator—Rear View, Dust Cover and Shield Covers Removed

NOTES: 1. Since an average reading of 60 is used for the receiver 40 mc modulator, occasionally difficulty may arise due to over-deviating an unusually sensitive modulator. If there is doubt, calibrate the individual modulator as is generally described in (c) below.

2. In all discriminator and modulator alignment tests the 200 μa test meter must *not* be connected to 2J5.

c. Connect the electronic voltmeter test equipment item 3 between 2J12-2 and ground on the receiver/modulator. Using the test unit "40 mc Var" oscillator as a deviation meter, set the test switch to the OVERALL position, turn Osc A off, Osc B on 30 kc and adjust the 30 kc level until the peak deviation is exactly ±750 kc. Measure the required modulator input. Limits 0.24 v to 0.37 v rms. Note the test unit meter current reading and use this value in place of the average value of 60.

Baseband Amplifier Check

a. Maintaining the conditions above, meter the 30 kc voltage on 2J12-5. Limits 0.75 v to 1.5 v.

TYPICAL RECEIVER/MODULATOR VOLTAGE AND METER READINGS

The following are approximate voltages existing between individual tube pins and ground as measured with the Voltohmyst with a 110k resistor in series with the probe. In the case of signal-dependent voltages the left-hand value is for no signal and the right-hand value for high signal. All voltages are dc unless otherwise noted.

Tube	*Type*	*Function*	*Pin #1*	*Pin #2*	*Pin #3*	*Pin #4*	*Pin #5*	*Pin #6*	*Pin #7*	*Pin #8*	*Pin #9*
2V1	6CB6	I.F.	-.20	0	6.1 ac	0	60	60	0	—	—
2V2	6CB6	I.F.	0	1.0	6.1 ac	0	80	80	0	—	—
2V3	6CB6	I.F.	0	1.0	6.1 ac	0	80	80	0	—	—
2V4	6CB6	I.F.	0	1.0	6.2 ac	0	80	80	0	—	—
2V5	6CB6	I.F.	0,-1.6	1.2,1.3	6.2 ac	0	80,70	80,70	0	—	—
2V6	6CB6	I.F.	0,-2.0	1.2,1.3	6.2 ac	0	80,65	80,65	0	—	—
2V7	6CB6	I.F.	0	3.0	6.3 ac	0	100	100	0	—	—
2V8	6CB6	I.F.	0	2.5	6.3 ac	0	100	107	0	—	—
2V9	6AL5	Disc.	0	-3.4	0	6.3 ac	var.	0	-3.4	—	—
2V10	6AS6	Mixer	-1.8,-.03	.85,.55	6.3 ac	0	33,64	33,64	0	—	—
2V11	6CB6	Amp.	0	1.4	6.3 ac	0	100	100	1.4	—	—
2V12	6AH6	Mod.	3.5	7.0	6.3 ac	0	160	135	7.0	—	—
2V13	12AT7	Osc.	160	2.7	4.4	0	0	160	+2.7	4.4	6.3 ac
2V14	12AT7	Osc/Relay	26,12	0.1,2.7	2.5	0	0	215,250	26,12	32,24	6.3 ac
2V15	6CB6	B.B.Amp.	3.2	4.1	6.3 ac	0	210	65	4.1	—	—
2V16	12AT7	S.Ch.Amp.	75	0	1.5	0	0	165	0	1.8	6.3 ac
2V17	12AX7	Lockout Amp.	125	0	1.5	0	0	125	0	1.5	6.3 ac
2V18	12AT7	Lockout Amp.	90	-3.0,0	2.0	0	0	200,250	33.0	35,15	6.3 ac

Voltages are positive unless noted. Var.—variable with received frequency.

The following are typical readings obtained using the 200 microamperes test meter (1M1) in the transmitter unit.

Xtal Cur.	(2J3):	-50 μa
Sig.	(2J4):	+5 μa no signal; +140 μa high signal
Disc.	(2J5):	zero for 30.0 mc I. F. signal; up to ±150 μa for off freq. signal. A typical value is ±30 μa for carrier frequencies different from 30 mc by ±1 mc.
Grid Cur.	(2J14):	+70 μa
Lockout Cur.	(2J15):	110 μa with no signal or low signal 55 μa with 2V1 removed from the socket

NOTE: The components affecting this output include 2V8. If it is necessary to change 2V8 in order to pass the above test, (b) and (c) of Discriminator Alignment must be redone. As an aid to isolating low baseband output difficulties, it may be desirable to note the discriminator deviation sensitivity. This has been found to average around 0.4 v rms for a peak deviation of ±0.75 mc. This voltage is measured at 2C61 with the electronic voltmeter. A 10 microhenry choke must be used in series with the hot lead of the electronic voltmeter.

Baseband Gain Control and Modulator Gain Control Adjustments

a. Maintain the distortion and modulation test unit set up as above, except remove the lead feeding the baseband output (2J12-5) to the test unit. Place a 22,000 ohm resistor between 2J12-5 and ground to properly terminate the baseband output.

b. Using the distortion and modulation test unit 35 mc modulated oscillator or some other source of standard deviation, calibrate the discriminator determining what ac voltage it delivers when the i-f signal is deviated ±1.5 mc.

c. Apply a 5 kc tone at a level of 0.85 volts to 2J12-2. Adjust the modulator gain control 2R109 until the discriminator voltage is the value measured in (b) above.

d. Measure the voltage between 2J12-5 and ground and adjust the baseband gain control 2R107 for 1.2 volt output.

Service Channel Amplifier Check

Apply a voltage at 1 kc from test equipment item. 2 to 2J12-2 at a level of 0.0425 v rms. This will deviate the oscillator by ±75 kc. The service channel output from 2J13-2 into 10k ohms should then be greater than 7 volts with 2R140 at its maximum clockwise position. Adjust 2R140 for a 7 volt output. Remove the resistors placed between 2J12-5 and ground and between 2J13-2 and ground.

For additional information on the use of the Distortion and Modulation Test Unit MI-31023-A (test item 11) consult the instructions supplied with the unit.

If the receiver/modulator unit is to be used in a terminal station remove wire "L". Retain this connection if the unit is to be used in a repeater station. Apply core sealing material to the tops of all tuning coils except 2L47 and 2L57. Also seal 2R107 and 2R109.

Service Channel Options

In order that the stations will operate correctly when using either of the service channel and fault systems (Repeater Service Unit MI-31495 and Terminal Service Unit MI-31496 or Service Channel Unit MI-31140, Indicon Coder MI-31138 and Indicon Decoder MI-31139), the receiver/modulator unit must be correctly connected internally to accommodate the specific equipment used. Figure RM-11 contains the information for making these connections.

Lockout Circuit

The lockout circuit of the receiver/modulator unit is used at all standby stations and at non-standby stations using the indicon service channel system (Service Channel Unit MI-31140, Indicon Coder Unit MI-31138 and Indicon Decoder Unit MI-31139).

To test and adjust the lockout circuit of the receiver/modulator perform the following steps:

1. Remove the rf signal from the receiver/modulator. Remove 2V1 and lockout relay 2K3.

2. Turn the "NOISE GAIN" potentiometer 2R115 fully clockwise. Note the current reading at the OPR CUR jack (the 0 to 200 μa test meter located in the transmitter may be used). The current should read between 40 and 60 μa.

3. Maintaining conditions as above, insert the lockout relay. The "OPR CUR" current should not rise more than 5 μa above the value noted in (2) above.

4. Maintaining conditions as above replace 2V1. The current at the "OPR CUR" jack should read between 110 and 190 μa.

5. Vary the "NOISE GAIN" potentiometer. Starting at the fully counter-clockwise position, note the OPR CUR reading at which the lockout relay just operates. This should be no more than 25 μa above the reading of (2) above. Adjust the "NOISE GAIN" for an "OPR CUR" reading of 110 μa.

NOTE: The current at the "OPR CUR" jack is dependent on the strength of the applied r-f signal. Therefore when an r-f signal is applied to the receiver/modulator the "OPR CUR" reading may drop from the 110 μa value

set above. With a very strong signal the current reading may drop to approximately the reading of (2) due to the saturation of i-f stage 2V5 which limits off the noise on the signal. Thus, when adjusting the "NOISE GAIN" control for the proper current reading it is important to remove the r-f signal from the receiver/modulator.

6. Check operation of the receiver/modulator relays and the lockout relay using the following table:

Condition	*B+ at 2V15-5*	*Voltage between 2J11-5 and 2J13-6*	*Voltage between 2J11-5 and 2J13-4*
With r-f signal	210 v dc	115 v ac	0
No r-f signal	0	0	0
2V1 removed	0	0	115 v ac

7. Restore the receiver/modulator to normal operating conditions.

REPLACEMENT PARTS LIST

Symbol No.	*Description*	*Drawing No.*	*Stock No.*
2C1	Part of 2Z1.		
2C2	Capacitor, fixed, ceramic, 1500 mmf +100 –0%, 500 v.	449696-3	73748
2C3	Capacitor, fixed, mica, 1000 mmf ±10%, 500 v.	984002-121	94189
2C4	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v.	735717-33	102015
2C5	Not used.		
2C6, 2C7	Capacitor, fixed, ceramic, 1500 mmf +100 –0%, 500 v. Same as 2C2.	449696-3	73748
2C8	Not used.		
2C9	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	102015
2C10	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v.	735717-427	93602
2C11, 2C12	Not used.		
2C13	Capacitor, fixed, ceramic, 1500 mmf +100 –0%, 500 v. Same as 2C2.	449696-3	73748
2C14	Not used.		
2C15	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	102015
2C16	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v. Same as 2C10	735717-427	93602
2C17	Not used.		
2C18	Capacitor, fixed, ceramic, 1500 mmf +100 –0%, 500 v. Same as 2C2.	449696-3	73748
2C19, 2C20	Not used.		
2C21	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	102015
2C22	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v. Same as 2C10	735717-427	93602
2C23	Not used.		
2C24	Capacitor, fixed, ceramic, 1500 mmf +100 –0%, 500 v. Same as 2C2.	449696-3	73748
2C25, 2C26	Not used.		
2C27	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	102015
2C28	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v. Same as 2C10	735717-427	93602
2C29, 2C30	Not used.		
2C31	Capacitor, fixed, ceramic, 1500 mmf +100 –0%, 500 v. Same as 2C2.	449696-3	73748
2C32	Not used.		
2C33	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	102015
2C34	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v. Same as 2C10	735717-427	93602
2C35	Capacitor, fixed, ceramic, 1500 mmf +100 –0%, 500 v. Same as 2C2	449696-3	73748
2C36	Capacitor, fixed, ceramic, 1500 mmf ±20%, 500 v.	8864187-2	204866
2C37	Capacitor, fixed, ceramic, 220 mmf ± 10%, 500 v.	984002-181	94222
2C38	Not used.		
2C39	Capacitor, fixed, ceramic, 1500 mmf +100 –0%, 500 v. Same as 2C2	449696-3	73748
2C40, 2C41	Not used.		

Symbol No.	Description	Drawing No.	Stock No.
2C42	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	102015
2C43	Capacitor, fixed, ceramic, 470 mmf ±10%, 500 v.	735717-37	94223
2C44	Not used.		
2C45	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v. Same as 2C10	735717-427	93602
2C46	Capacitor, fixed, ceramic, 1500 mmf +100 –0%, 500 v. Same as 2C2	449696-3	73748
2C47, 2C48	Not used.		
2C49	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	102015
2C50	Capacitor, fixed, headed lead, 4.7 mmf ±20%, 500 v.	99327-6	54402
2C51	Capacitor, fixed, ceramic, 470 mmf ±10%, 500 v. Same as 2C43	735717-37	94223
2C52	Not used.		
2C53	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v. Same as 2C10	735717-427	93602
2C54	Capacitor, fixed, mica, 1000 mmf ±10%, 500 v. Same as 2C3	984002-121	94189
2C55	Capacitor, fixed, ceramic, 1500 mmf +100 –0%, 500 v. Same as 2C2	449696-3	73748
2C56, 2C57	Not used.		
2C58	Capacitor, fixed, ceramic, 22 mmf ±10%, 500 v.	735717-21	59437
2C59, 2C60	Capacitor, fixed, mica, 1000 ±10%, 500 v. Same as 2C3	984002-121	94189
2C61	Capacitor, fixed, mica, 50 mmf ±10%, 500 v.	984002-161	94224
2C62	Capacitor, fixed, paper, 0.01 mf ±10%, 400 v.	735715-163	73561
2C63 to 2C65	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	102015
2C66	Capacitor, fixed, ceramic, 1500 mmf ±20%, 500 v. Same as 2C36	8864187-2	204866
2C67	Not used.		
2C68	Capacitor, fixed, paper, 0.0047 mf ±10%, 600 v.	735715-259	73920
2C69	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v.	735715-175	73551
2C70	Capacitor, fixed, ceramic, 150 mmf ±10%, 500 v.	735717-431	78276
2C71A, B, C	Capacitor, electrolytic, 10/10/10 mf, 400 v.	449618-1	56304
2C72	Capacitor, fixed, paper, 0.068 mf ±10%, 400 v.	735715-173	73792
2C73	Capacitor, fixed, ceramic, 680 mmf ±10%, 500 v.	735717-439	78305
2C74	Capacitor, fixed, ceramic, 1500 mmf ±10%, 500 v.	735717-443	75610
2C75	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v. Same as 2C69	735715-175	73551
2C76	Capacitor, fixed, ceramic, 470 mmf ±10%, 500 v. Same as 2C43	735717-37	94223
2C77	Capacitor, fixed, ceramic, 6.8 mmf ±1 mmf, 500 v.	90581-305	39043
2C78	Capacitor, fixed, ceramic, 820 mmf + 100 –0%, 500 v.	449696-1	94190
2C79	Capacitor, fixed, paper, 0.047 mf ±10%, 400 v.	735715-171	73553
2C80	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v. Same as 2C10	735717-427	93602
2C81	Capacitor, fixed, ceramic, 100 mmf ±10%, 500 v.	735717-29	93515
2C82	Capacitor, fixed, headed lead type, 0.68 mmf ±10%, 500 v.	99327-11	71504
2C83	Not used.		
2C84	Capacitor, fixed, ceramic, 1500 mmf +100 –0%, 500 v. Same as 2C2	449696-3	73748
2C85	Capacitor, fixed, ceramic, 820 mmf + 100 –0%, 500 v. Same as 2C78	449696-1	94190
2C86	Capacitor, fixed, ceramic, 1500 mmf ±20%, 500 v. Same as 2C36	8864187-2	204866
2C87	Capacitor, fixed, ceramic, 820 mmf + 100 –0%, 500 v. Same as 2C78	449696-1	94190
2C88	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	102015
2C89	Capacitor, fixed, ceramic, 820 mmf + 100 –0%, 500 v. Same as 2C78	449696-1	94190
2C90	Capacitor, fixed, headed lead type, 1.5 mmf ±10%, 500 v.	99327-13	71500
2C91	Capacitor, fixed, ceramic, 820 mmf + 100 –0%, 500 v. Same as 2C78	449696-1	94190
2C92	Capacitor, fixed, ceramic, 470 mmf ±10%, 500 v. Same as 2C43	735717-37	94223
2C93, 2C94	Capacitor, fixed, ceramic, 1500 mmf ±20%, 500 v. Same as 2C36	8864187-2	204866
2C95	Capacitor, fixed, ceramic, 10 mmf ±20%, 500 v.	8892567-4	94227
2C96	Not used.		
2C97	Capacitor, fixed, paper, 0.033 mf ±10%, 400 v.	735715-169	73552
2C98	Capacitor, fixed, ceramic, 12 mmf ±10%, 500 v.	735717-418	94228

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Symbol No.	*Description*	*Drawing No.*	*Stock No.*
2C99	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v. Same as 2C10	735717-427	93602
2C100	Capacitor, fixed, ceramic, 390 mmf ±10%, 500 v.	735717-436	75641
2C101 to 2C103	Capacitor, fixed, ceramic, 1500 mmf +100 -0%, 500 v. Same as 2C2	449696-3	73748
2C104	Capacitor, fixed, ceramic, 1500 mmf ±20%, 500 v. Same as 2C36	8864187-2	204866
2C105, 2C106	Capacitor, fixed, ceramic, 1500 mmf +100 -0%, 500 v. Same as 2C2	449696-3	73748
2C107	Capacitor, fixed, ceramic, 1500 mmf ±20%, 500 v. Same as 2C36	8864187-2	204866
2C108, 2C109	Capacitor, fixed, ceramic, 1500 mmf +100 -0%, 500 v. Same as 2C2	449696-3	73748
2C110	Capacitor, fixed, headed lead type, 1.0 mmf ±10%, 500 v.	99327-12	55331
2C111	Not used.		
2C112, 2C113	Capacitor, fixed, ceramic, 1500 mmf +100 -0%, 500 v. Same as 2C2	449696-3	73748
2C114	Capacitor, fixed, mica, 820 mmf ±5%, 500 v.	727868-245	39650
2C115, 2C116	Capacitor, fixed, ceramic, 10,000 mmf +100 -0%, 450 v.	449696-55	59997
2C117	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v. Same as 2C69	735715-175	73551
2C118	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	102015
2C119	Capacitor, fixed, ceramic, 10,000 mmf +100 -0%, 450 v. Same as 2C115	449696-55	59997
2C120	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v. Same as 2C69	735715-175	73551
2C121, 2C122	Capacitor, fixed, ceramic, 10,000 mmf +100 -0%, 450 v. Same as 2C115	449696-55	59997
2C123	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v. Same as 2C69	735715-175	73551
2C124	Capacitor, fixed, ceramic, 10,000 mmf +100 -0%, 450 v. Same as 2C115	449696-55	59997
2C125	Capacitor, fixed. paper, 0.047 mf ±10%, 200 v.	735715-71	73558
2C126	Capacitor, fixed, headed lead type, 4.7 mmf ±20%, 500 v.	99327-6	54402
2C127	Capacitor, fixed, paper, 0.047 mf ±10%, 400 v. Same as 2C79	735715-171	73553
2C128	Capacitor, fixed, ceramic, 680 mmf ±10%, 500 v. Same as 2C73	735717-439	78305
2C129	Capacitor, fixed, ceramic, 1500 mmf +100 -0%, 500 v. Same as 2C2	449696-3	73748
2C130	Capacitor, fixed, ceramic, 220 mmf +100 -0%, 500 v.	990167-9	77625
2C131	Capacitor, fixed, ceramic, 1500 mmf +100 -0%, 500 v. Same as 2C2	449696-3	73748
2C132, 2C133	Capacitor, fixed, ceramic, 1000 mmf +100 -20%, 500 v.	449696-2	77252
2C134	Capacitor, fixed, ceramic, 1500 mmf +100 -0%, 500 v. Same as 2C2	449696-3	73748
2C135, 2C136	Capacitor, fixed, ceramic, 1000 mmf +100 -20%, 500 v. Same as 2C132	449696-2	77252
2C137	Capacitor, fixed, ceramic, 1500 mmf +100 -0%, 500 v. Same as 2C2	449696-3	73748
2C138	Capacitor, fixed, ceramic, 1000 mmf +100 -20%, 500 v. Same as 2C132	449696-2	77252
2C139	Capacitor, fixed, mica, 1000 mmf ±10%, 500 v. Same as 2C3	984002-121	94189
2C140 to 2C143	Capacitor, fixed, ceramic, 1000 mmf ±20%, 500 v.	8825449-1	99177
2C144, 2C145	Capacitor, fixed, headed lead, 4.7 mmf ±20%, 500 v. Same as 2C50	99327-6	54402
2CR1	Rectifier, crystal diode IN21B	IN21B	67876
2CR2 to 2CR7	Rectifier, crystal diode CK705	CK705	94229
2J1	Connector, male, coaxial, chassis mtg., including 0.511 lg. probe	456961-501	95392
2J2	Coupling loop, comprising 1 female coaxial, chassis mtg. connector, sleeve, and 33 ohm ½ w resistor	8834436-501	94231
2J3 to 2J5	Connector, pin jack	742565-1	93678
2J6	Not used.		
2J7	Connector, pin jack. Same as 2J3	742565-1	93678
2J8, 2J9	Connector, female, coaxial, chassis mtg.	8845666-1	94205
2J10	Not used.		
2J11	Connector, male, 6 contact, chassis mtg.	181494-3	28507
2J12	Connector, female, 6 contact, chassis mtg.	181494-4	18534
2J13	Connector, male, 6 contact, chassis mtg. Same as 2J11	181494-3	28507
2J14, 2J15	Connector, pin jack. Same as 2J3	742565-1	93678
2K1	Relay, coil, 8000 ohm, contacts, s.p.d.t., plug-in type	8888583-1	56316
2K2	Relay, coil, 115 v. ac, 50/60 cy. contacts, d.p.d.t.	458952-1	95350
2K3	Relay, coil, 8000 ohm, contact, s.p.d.t. plug-in type. Same as 2K1	8888583-1	56316

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Symbol No.	*Description*	*Drawing No.*	*Stock No.*
2L1	Coil, adj. core, 18 turns	629132-511	94233
2L2	Coil, adj. core, 32 turns	629132-506	94234
2L3	Coil, adj. core, 22 turns	629132-509	94235
2L4	Reactors, r-f choke, 7.5 microhenry, 275 ma	459688-76	205050
2L5	Coil, adj. core, 33 turns	629132-505	94236
2L6	Coil, adj. core, 40 turns	629132-503	94237
2L7	Coil, adj. core, 19 turns	629132-510	94238
2L8	Reactor, r-f choke, 2.4 microhenry	8834424-501	94040
2L9	Not used.		
2L10	Coil, adj. core, 33 turns. Same as 2L5	629132-505	94236
2L11	Coil, adj. core, 40 turns. Same as 2L6	629132-503	94237
2L12	Coil, adj. core, 19 turns. Same as 2L7	629132-510	94238
2L13	Reactor, r-f choke, 2.4 microhenry. Same as 2L8	8834424-501	94040
2L14	Reactor, r-f choke, 7.5 microhenry, 275 ma. Same as 2L4	459688-76	205050
2L15	Coil, adj. core, 33 turns. Same as 2L5	629132-505	94236
2L16	Coil, adj. core, 40 turns. Same as 2L6	629132-503	94237
2L17	Coil, adj. core, 19 turns. Same as 2L7	629132-510	94238
2L18	Reactor, r-f choke, 2.4 microhenry. Same as 2L8	8834424-501	94040
2L19	Reactor, r-f choke, 7.5 microhenry, 275 ma. Same as 2L4	459688-76	205050
2L20	Coil, adj. core, 33 turns. Same as 2L5	629132-505	94236
2L21	Coil, adj. core, 40 turns. Same as 2L6	629132-503	94237
2L22	Coil, adj. core, 19 turns. Same as 2L7	629132-510	94238
2L23	Reactor, r-f choke, 2.4 microhenry. Same as 2L8	8834424-501	94040
2L24	Reactor, r-f choke, 7.5 microhenry, 275 ma. Same as 2L4	459688-76	205050
2L25	Coil, adj. core, 33 turns. Same as 2L5	629132-505	94236
2L26	Coil, adj. core, 40 turns. Same as 2L6	629132-503	94237
2L27	Coil, adj. core, 19 turns. Same as 2L7	629132-510	94238
2L28	Reactor, r-f choke, 2.4 microhenry. Same as 2L8	8834424-501	94040
2L29, 2L30	Reactor, r-f choke, 7.5 microhenry, 275 ma. Same as 2L4	459688-76	205050
2L31	Coil, adj. iron core, 15 turns	629132-526	94210
2L32	Reactor, r-f choke, 2.4 microhenry. Same as 2L8	8834424-501	94040
2L33, 2L34	Reactor, r-f choke, 7.5 microhenry, 275 ma. Same as 2L4	459688-76	205050
2L35	Coil, adj. iron core, 14 turns	629132-527	94239
2L36	Reactor, r-f choke, 2.4 microhenry. Same as 2L8	8834424-501	94040
2L37 to 2L39	Reactor, r-f choke, 7.5 microhenry, 275 ma. Same as 2L4	459688-76	205050
2L40	Coil, adj. iron core, 28 turns	629132-507	94240
2L41	Coil, adj. core, 22 turns. Same as 2L3	629132-509	94235
2L42	Coil, adj. iron core, 32 turns with conductive cloth covering	629132-528	96463
2L43	Reactor, r-f choke, 50 microhenry, 33 ma	8834437-502	94242
2L44	Reactor, r-f choke, 2.4 microhenry. Same as 2L8	8834424-501	94040
2L45, 2L46	Reactor, r-f choke, 7.5 microhenry, 275 ma. Same as 2L4	459688-76	205050
2L47	Coil, adj. iron core, 6 turns	629132-520	94211
2L48	Not used.		
2L49, 2L50	Coil, adj. iron core, 16 turns	629132-513	94241
2L51	Reactor, r-f choke, 7.5 microhenry, 275 ma. Same as 2L4	459688-76	205050
2L52	Coil, adj. iron core, 13 turns	629132-514	94244
2L53	Coil, adj. core, 22 turns. Same as 2L3	629132-509	94235
2L54	Coil, adj. iron core, 8 turns	629132-517	94245
2L55	Coil, adj. iron core, 10 turns	629132-516	94246
2L56	Coil, adj. iron core, 4 turns	629132-524	94208
2L57	Coil, adj. iron core, 11 turns	629132-535	205051

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Symbol No.	Description	Drawing No.	Stock No.
2L58	Coil, adj. iron core, 14 turns. Same as 2L35	629132-527	94239
2L59	Reactor, r-f choke, 2.4 microhenry. Same as 2L8	8834424-501	94040
2L60	Reactor, r-f choke, 7.5 microhenry, 275 ma. Same as 2L4	459688-76	205050
2L61	Reactor, r-f choke, 7 microhenry, 1000 ma	8834437-503	57259
2L62	Reactor, r-f inductor	8834423-502	95885
2L63	Reactor, r-f inductor	8834425-503	98387
	Core, tuning iron, threaded type, ¼-28 x ⅜" lg., with fiber nut and spring washer (for above coils)	8832091-2	208637
2R1	Not used.		
2R2	Resistor, fixed, composition, 4700 ohm ±5%, ½ w.	82283-175	502247
2R3 to 2R5	Not used.		
2R6	Resistor, fixed, composition, 33 ohm ±10%, ½ w.	82283-44	502033
2R7	Not used.		
2R8	Resistor, fixed, composition, 4700 ohm ±5%, ½ w. Same as 2R2	82283-175	502247
2R9, 2R10	Not used.		
2R11	Resistor, fixed, composition, 68 ohm ±5%, ½ w.	82283-131	502068
2R12	Not used.		
2R13	Resistor, fixed, composition, 4700 ohm ±5%, ½ w. Same as 2R2	82283-175	502247
2R14, 2R15	Not used.		
2R16	Resistor, fixed, composition, 150 ohm ±10%, ½ w.	82283-52	502115
2R17	Not used.		
2R18	Resistor, fixed, composition, 4700 ohm ±5%, ½ w. Same as 2R2	82283-175	502247
2R19, 2R20	Not used.		
2R21	Resistor, fixed, composition, 27,000 ohm ±5%, ½ w.	82283-193	502327
2R22	Not used.		
2R23	Resistor, fixed, composition, 4700 ohm ±5%, ½ w. Same as 2R2	82283-175	502247
2R24	Not used.		
2R25	Resistor, fixed, composition, 470 ohm ±10%, ½ w.	82283-58	502147
2R26	Resistor, fixed, composition, 100 ohm ±10%, ½ w.	82283-50	502110
2R27	Resistor, fixed, composition, 1000 ohm ±10%, ½ w.	82283-62	502210
2R28	Not used.		
2R29, 2R30	Resistor, fixed, composition, 390 ohm ±10%, ½ w.	82283-57	502139
2R31	Resistor, fixed, composition, 3900 ohm ±5%, ½ w.	82283-173	502239
2R32	Resistor, fixed, composition, 12,000 ohm ±10%, 1 w.	90496-75	512312
2R33, 2R34	Resistor, fixed, composition, 390 ohm ±10%, ½ w. Same as 2R29	82283-57	502139
2R35	Resistor, fixed, composition, 3900 ohm ±5%, ½ w. Same as 2R31	82283-173	502239
2R36	Resistor, fixed, composition, 12000 ohm ±10%, 1 w. Same as 2R32	90496-75	512312
2R37	Resistor, fixed, composition, 2200 ohm ±5%, ½ w.	82283-167	502222
2R38, 2R39	Resistor, fixed, composition, 3300 ohm ±5%, ½ w.	82283-171	502233
2R40	Resistor, fixed, composition, 27,000 ohm ±5%, ½ w. Same as 2R21	82283-193	502327
2R41	Resistor, fixed, composition, 470,000 ohm ±10%, ½ w.	82283-94	502447
2R42	Resistor, fixed, wire wound, 22,000 ohm ±5%, 5 w.	458572-90	59175
2R43, 2R44	Resistor, fixed, composition, 1 megohm ±10%, ½ w.	82283-98	502510
2R45	Resistor, fixed, composition, 560,000 ohm ±10%, ½ w.	82283-95	502456
2R46	Resistor, variable, composition, 25,000 ohm ±10%, 2 w.	737829-31	94192
2R47	Resistor, fixed, composition, 2200 ohm ±10%, 1 w.	90496-66	512222
2R48	Resistor, fixed, composition, 1 megohm ±10%, ½ w. Same as 2R43	82283-98	502510
2R49	Resistor, fixed, composition, 120 ohm ±5%, ½ w.	82283-137	502112
2R50	Resistor, fixed, composition, 470 ohm ±5%, ½ w.	82283-151	502147
2R51	Not used.		
2R52	Resistor, fixed, composition, 100,000 ohm ±5%, ½ w.	82283-207	502410

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Symbol No.	Description	Drawing No.	Stock No.
2R53	Resistor, fixed, composition, 1000 ohm ±5%, ½ w.	82283-159	502210
2R54	Resistor, fixed, composition, 220,000 ohm ±5%, ½ w.	82283-215	502422
2R55	Resistor, fixed, composition, 470,000 ohm ±5%, ½ w.	82283-223	502447
2R56	Resistor, fixed, composition, 270,000 ohm ±5%, ½ w.	82283-217	502427
2R57	Resistor, fixed, composition, 150,000 ohm ±5%, ½ w.	82283-211	502415
2R58	Resistor, fixed, composition, 180,000 ohm ±5%, ½ w.	82283-213	502418
2R59	Resistor, fixed, composition, 390 ohm ±5%, ½ w.	82283-149	502139
2R60	Resistor, fixed, composition, 18,000 ohm ±10%, 2 w.	99126-77	522318
2R61	Resistor, fixed, composition, 10,000 ohm ±5%, ½ w.	82283-183	502310
2R62	Resistor, fixed, composition, 100,000 ohm ±5%, ½ w. Same as 2R52	82283-207	502410
2R63	Resistor, fixed, composition, 100,000 ohm ±5%, 1 w.	90496-207	512410
2R64	Not used.		
2R65	Resistor, fixed, composition, 47,000 ohm ±5%, 2 w.	99126-199	522347
2R66	Not used.		
2R67	Resistor, fixed, composition, 22,000 ohm ±5%, ½ w.	82283-191	502322
2R68	Resistor, fixed, composition, 1500 ohm ±5%, ½ w.	82283-163	502215
2R69	Resistor, fixed, composition, 120 ohm ±5%, ½ w. Same as 2R49	82283-137	502112
2R70	Resistor, fixed, composition, 1000 ohm ±5%, ½ w. Same as 2R53	82283-159	502210
2R71	Resistor, fixed, wire wound, 4800 ohm ±5%, 5 w.	458572-66	211398
2R72	Resistor, fixed, composition, 39,000 ohm ±10%, 2 w.	99126-81	522339
2R73	Resistor, fixed, composition, 4700 ohm ±5%, ½ w. Same as 2R2	82283-175	502247
2R74	Resistor, fixed, composition, 2700 ohm ±5%, ½ w.	82283-169	502227
2R75	Resistor, fixed, composition, 220 ohm ±5%, ½ w.	82283-143	502122
2R76	Resistor, fixed, composition, 22,000 ohm ±10%, 2 w.	99126-78	522322
2R77	Resistor, fixed, composition, 5600 ohm ±5%, ½ w.	82283-177	502256
2R78 to 2R81	Not used.		
2R82	Resistor, fixed, composition, 2700 ohm ±5%, ½ w. Same as 2R74	82283-169	502227
2R83	Resistor, fixed, composition, 100,000 ohm ±5%, ½ w. Same as 2R52	82283-207	502410
2R84	Not used.		
2R85	Resistor, fixed, composition, 27,000 ohm ±10%, 2 w.	99126-79	522327
2R86	Resistor, fixed, composition, 100,000 ohm ±10%, ½ w.	82283-86	502410
2R87	Resistor, fixed, composition, 10,000 ohm ±10%, 1 w.	90496-74	512310
2R88	Resistor, fixed, composition, 2200 ohm ±5%, ½ w. Same as 2R37	82283-167	502222
2R89	Resistor, fixed, composition, 150 ohm ±10%, ½ w. Same as 2R16	82283-52	502115
2R90	Resistor, fixed, composition, 10,000 ohm ±10%, 1 w. Same as 2R87	90496-74	512310
2R91	Resistor, fixed, composition, 2200 ohm ±5%, ½ w. Same as 2R37	82283-167	502222
2R92	Resistor, fixed, composition, 150 ohm ±10%, ½ w. Same as 2R16	82283-52	502115
2R93	Resistor, fixed, composition, 10,000 ohm ±10%, 1 w. Same as 2R87	90496-74	512310
2R94	Resistor, fixed, composition, 2200 ohm ±5%, ½ w. Same as 2R37	82283-167	502222
2R95	Resistor, fixed, composition, 150 ohm ±10%, ½ w. Same as 2R16	82283-52	502115
2R96	Resistor, fixed, composition, 10,000 ohm ±10%, 1 w. Same as 2R87	90496-74	512310
2R97	Resistor, fixed, composition, 2200 ohm ±5%, ½ w. Same as 2R37	82283-167	502222
2R98	Resistor, fixed, composition, 150 ohm ±10%, ½ w. Same as 2R16	82283-52	502115
2R99	Resistor, fixed, composition, 10,000 ohm ±10%, 1 w. Same as 2R87	90496-74	512310
2R100	Resistor, fixed, composition, 2200 ohm ±5%, ½ w. Same as 2R37	82283-167	502222
2R101	Resistor, fixed, composition, 10,000 ohm ±10%, 1 w. Same as 2R87	90496-74	512310
2R102	Resistor, fixed, composition, 100 ohm ±10%, ½ w. Same as 2R26	82283-50	502110
2R103, 2R104	Resistor, fixed, composition, 560 ohm ±10%, ½ w.	82283-59	502156
2R105, 2R106	Resistor, fixed, composition, 4700 ohm ±5%, ½ w. Same as 2R2	82283-175	502247
2R107	Resistor, variable, composition, 5000 ohm ±10%, 2 w.	737829-30	94039
2R108	Resistor, fixed, composition, 2200 ohm ±5%, ½ w. Same as 2R37	82283-167	502222

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Symbol No.	*Description*	*Drawing No.*	*Stock No.*
2R109	Resistor, variable, composition, 10,000 ohm ±10%, 2 w.	737801-44	58983
2R110	Resistor, fixed, composition, 4700 ohm ±5%, ½ w. Same as 2R2	82283-175	502247
2R111	Resistor, fixed, composition, 470,000 ohm ±10%, ½ w. Same as 2R41	82283-94	502447
2R112	Resistor, fixed, composition, 3900 ohm ±5%, ½ w. Same as 2R31	82283-173	502239
2R113	Resistor, fixed, composition, 220,000 ohm ±5%, ½ w. Same as 2R54	82283-215	502422
2R114	Resistor, fixed, composition, 100,000 ohm ±10%, ½ w. Same as 2R86	82283-86	502410
2R115	Resistor, variable, 1 megohm ±20%, 2 w.	746053-22	98077
2R116	Resistor, fixed, composition, 3900 ohm ±5%, ½ w. Same as 2R31	82283-173	502239
2R117	Resistor, fixed, composition, 220,000 ohm ±5%, ½ w. Same as 2R54	82283-215	502422
2R118	Resistor, fixed, composition, 100,000 ohm ±10%, ½ w. Same as 2R86	82283-86	502410
2R119	Resistor, fixed, composition, 680,000 ohm ±10%, ½ w.	82283-96	502468
2R120	Resistor, fixed, composition, 3900 ohm ±5%, ½ w. Same as 2R31	82283-173	502239
2R121	Resistor, fixed, composition, 220,000 ohm ±5%, ½ w. Same as 2R54	82283-215	502422
2R122	Resistor, fixed, composition, 100,000 ohm ±10%, ½ w. Same as 2R86	82283-86	502410
2R123	Resistor, fixed, composition, 560,000 ohm ±10%, ½ w. Same as 2R45	82283-95	502456
2R124	Resistor, fixed, composition, 3300 ohm ±5%, ½ w. Same as 2R38	82283-171	502233
2R125	Resistor, fixed, composition, 270,000 ohm ±5%, ½ w. Same as 2R56	82283-217	502427
2R126	Resistor, fixed, wire wound, 56,000 ohm ±5%, 10 w.	458574-90	53702
2R127	Resistor, fixed, composition, 470,000 ohm ±10%, ½ w. Same as 2R41	82283-94	502447
2R128	Resistor, fixed, wire wound, 75 ohm ±10%, 20 w.	8811127-1	16239
2R129	Resistor, fixed, composition, 15,000 ohm ±5%, ½ w.	82283-187	502315
2R130	Resistor, fixed, composition, 68,000 ohm ±5%, 2 w.	99126-203	522368
2R131	Resistor, fixed, carbon film type, 1000 ohm ±1%, ½ w.	990185-301	207762
2R132	Resistor, fixed, composition, 390,000 ohm ±5%, ½ w.	82283-221	502439
2R133	Resistor, fixed, carbon film type, 182 ohm ±1%, ½ w.	990185-226	207833
2R134	Not used.		
2R135	Resistor, fixed, composition, 10 ohm ±5%, ½ w.	82283-111	502010
2R136	Resistor, fixed, composition, 1000 ohm ±5%, ½ w. Same as 2R53	82283-159	502210
2R137	Resistor, fixed, wire wound, 1750 ohm ±10%, 25 w.	8817665-21	206726
2R138	Resistor, fixed, composition, 10,000 ohm ±10%, 2 w.	99126-74	522310
2R139	Resistor, fixed, composition, 470,000 ohm ±10%, ½ w. Same as 2R41	82283-94	502447
2R140	Resistor, variable, composition, 500,000 ohm ±20%, 2 w.	737887-12	206494
2R141	Resistor, fixed, composition, 270 ohm ±5%, ½ w.	735730-145	502127
2S1	Switch, push type, s.p.d.t., with black button	8835332-2	95572
2T1	Transformer, filament	8874796-1	57650
2X1 to 2X12	Socket, tube, 7 pin miniature	737867-18	94879
2X13, 2X14	Socket, tube, 9 pin miniature	984055-2	94880
2X15	Socket, tube, 7 pin miniature. Same as 2X1	737867-18	94879
2X16 to 2X18	Socket, tube, 9 pin miniature. Same as 2X13	984055-2	94880
2X19, 2X20	Socket, tube, 5 pin	849224-1	43639
2X21	Socket, tube, octal, red bakelite	746008-34	94879
2Z1	Cavity assembly, not stocked complete—associated parts below	458907-502	
	Contact, beryllium copper, for 2Z1	8834416-1	94390
	Core, brass tuning, ⅛-24 thread, 1 1/16" lg., 2Z1 tuning	8831031-1	95393
	Insulator, teflon, coated glass fabric, 1 3/16" x 13/10" x 0.010" thick (4 req'd) (for 2Z1)	8834415-1	94389
	Nut, hex, brass #⅛-24 thread tuning core locking (for 2Z1)	874927-6	95395
	Washer, spring ⅞" O.D. x 21/32" I.D. x 0.25" thick, beryllium copper, tuning core tension (for 2Z1)	8831068-2	95394

Approved For Release 2001/03/04 : CIA-RDP79T01049A002600030004-6

Symbol No.	Description	Drawing No.	Stock No.
	Miscellaneous		
	Connector, male, coaxial, cable mtg.	8898625-501	54392
	Screw, thumb, #10-32, 1" lg. back cover holding	8886111-2	94391
	Shield, tube, 7 pin miniature, 1¾" lg.	99369-2	54521
	Shield, tube, 7 pin miniature, 1⅜" lg.	99369-1	53016
	Shield, tube, 9 pin miniature, 1 15/16" lg.	8858642-3	56359
	Terminal, stand off melamine body, 27/32" lg., with #4-40 tapped mtg. hole	8886187-1	211646

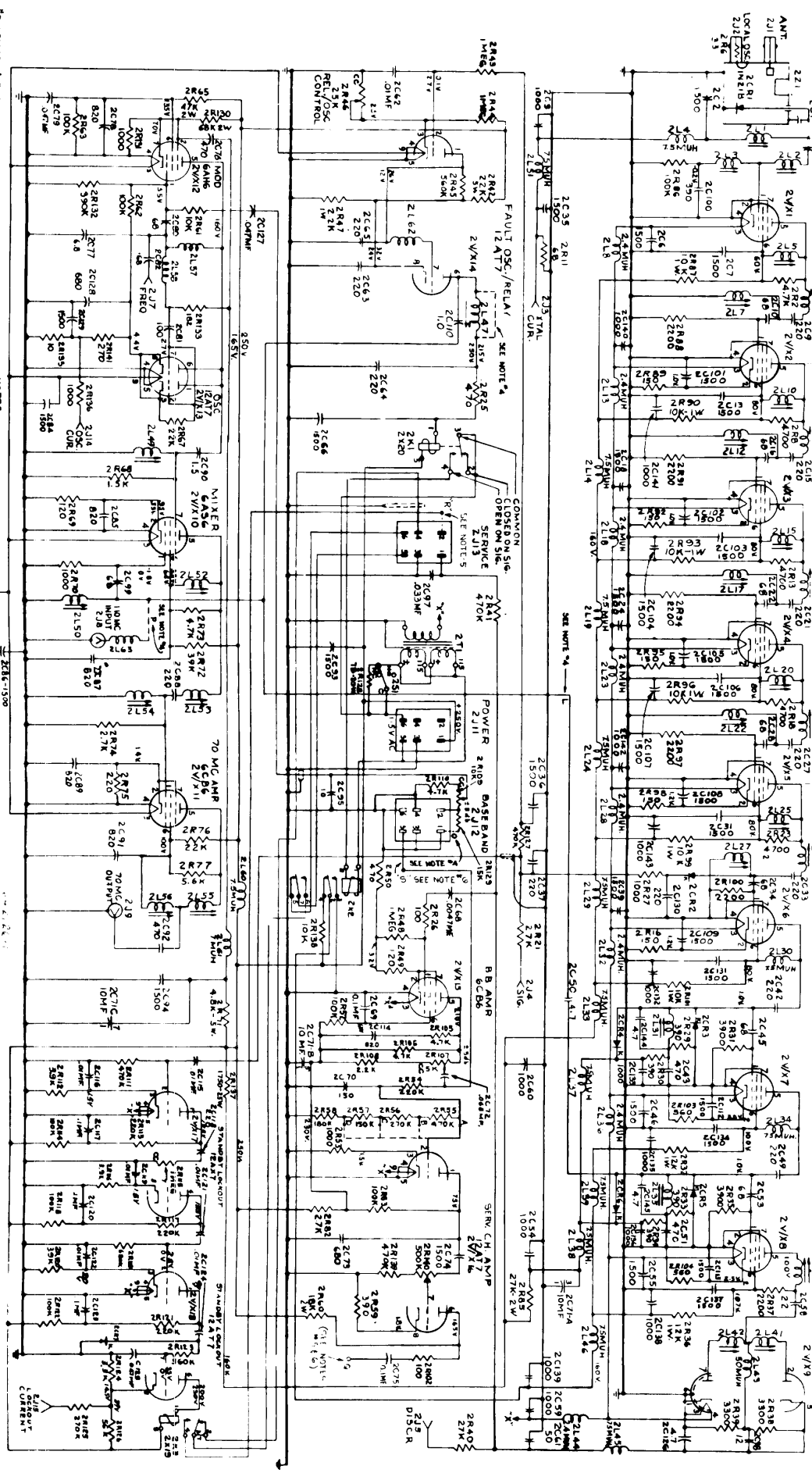
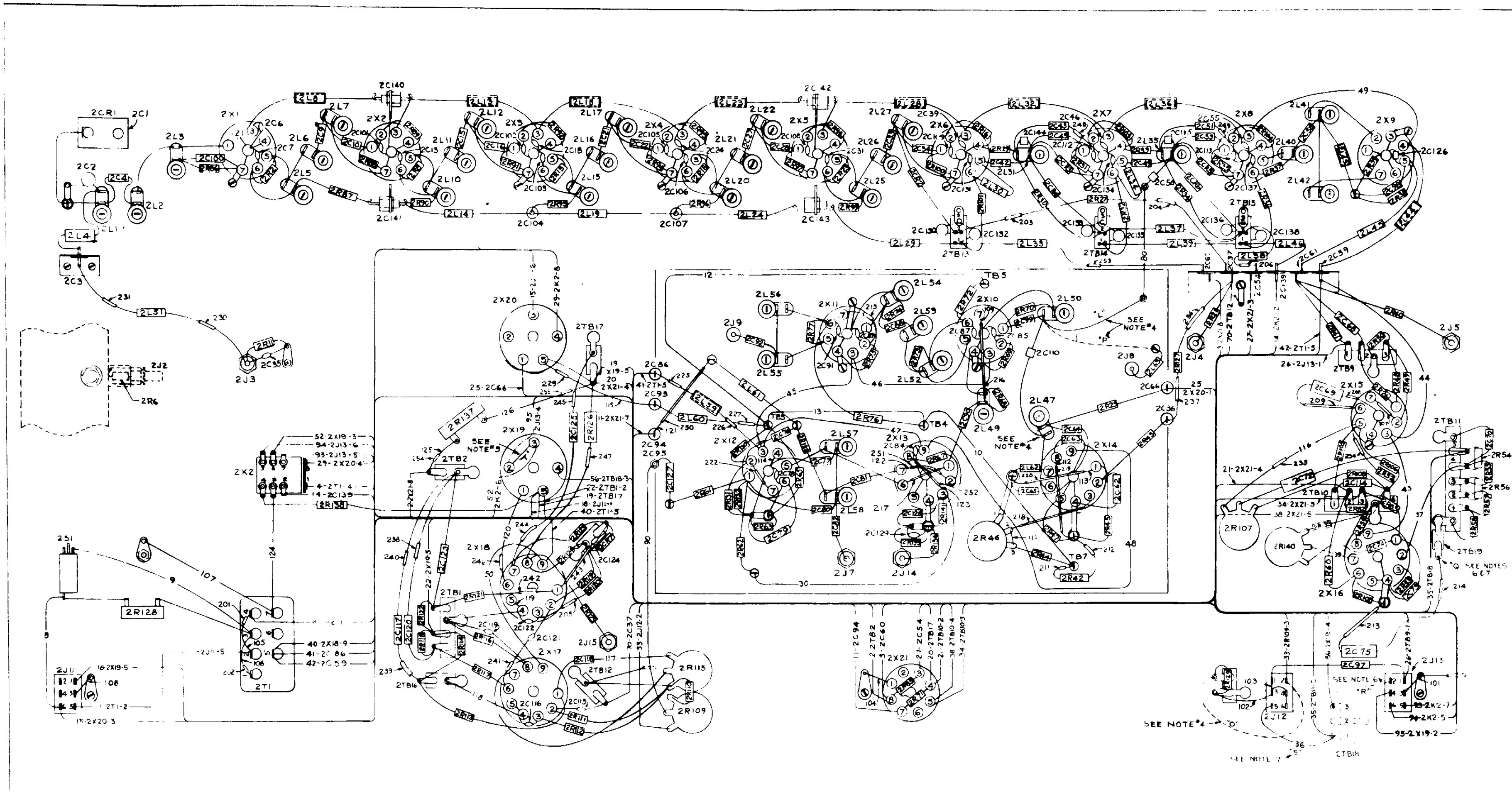


Figure RM-11—Receiver/Modulator—Schematic Diagram



WIRE TABLE			A-8926364 501		
WIRE NOS (INCLUSIVE)	DESCRIPTION COLOR AND CONDUCTOR		PS NO. OR DRAWING NO.	PTS LIST ITEM NO.	WIRE NOS. NOT USED.
1 TO 4	WHT-BLUE	7 X .010	PS 805-6	89	
8 TO 15	WHITE			90	
18 TO 22	WHT-RED			91	
25 TO 30	WHT-YEL			92	28
33 TO 39	WHT-GRN.	7 X .010	PS 805-6	93	
40 TO 50	WHT-BRN/GRN.	16 X .010	PS 805-8	94	
52	WHT-GRN/BLK.	7 X .010	PS 805-6	76	
56	WHT-BLK.	7 X .010	PS 805-6	78	
70	WHITE	SHIELDED WIRE	8845679-1	86	
80	BUS WIRE	(INSULATED)	8836025-1	96	
90	RF CABLE	RG 58/U	PS 745-58	87	
93	WHITE	3 CONDUCTOR SHIELDED CABLE	460202-502	98	
94	WHT-BLUE				
95	WHT-YEL.				
101 TO 104	TINNED COPPER WIRE	.032 DIA.	PS 105	85	
105 TO 107	TINNED COPPER WIRE	.050 DIA.	PS 105	79	
108 TO 126	TINNED COPPER WIRE	.032 DIA.	PS 105	85	110
201 TO 255	BLK. INS. TUBING	.053 I.D.	PS 8	82	210, 221, 223, 232, 224, 228, 233

NOTES:-

1- DESIGNATION IN WIRES ARE WIRE NUMBERS AND THEIR DESTINATIONS.

2- SOLDER ALL ELECTRICAL CONNECTIONS USING ITEM 88. ALL WIRING TO BE IN ACCORDANCE WITH RCA STANDARD PRACTICE.

3- CABLE AND THEN LACE WIRES, WHERE NECESSARY, USING LACING CORD, ITEM 80.

4- WHEN RECEIVER IS USED IN TERMINAL STATION ADD "O" & "P" LEADS, DISCONNECT LEAD "L" AT 2C99 & SHORT 2L47.

5- CONNECTION "T" (2X19-2 TO 2X19-3) IS OMITTED WHEN RECEIVER IS USED IN A SYSTEM WITH STANDBY EQUIPMENT, AND/OR INDICON SERVICE CHANNEL SYSTEM

6- CONNECT "Q" TO 2J13-2 AND OMIT LEAD "R" FOR STATIONS USING RPTR SERVICE UNIT MI-31495 OR TERM SERVICE UNIT MI-31496. ADD LEAD "R" AND LEAVE "Q" UNCONNECTED AT TERMINAL AND DROP RPTR STATIONS USING INDICON SERVICE CHANNEL SYSTEM.

7- DISCONNECT LEAD "S" AND CONNECT "Q" TO 2J12-5 AT THRU RPTR STATIONS USING INDICON SERVICE CHANNEL SYSTEM, AND ALL LEAD [illegible]

Figure RM-12—Receiver/Modulator—Wiring Diagram

G

MICROWAVE COMMUNICATION EQUIPMENT

Baseband Unit MI-31120

- TECHNICAL DATA
- DESCRIPTION
- MAINTENANCE
- REPLACEMENT PARTS

RADIO CORPORATION OF AMERICA
COMMERCIAL ELECTRONIC PRODUCTS, CAMDEN, N. J.

Printed in U.S.A.
WA 576-B57

IB-33238-2

TECHNICAL DATA

Power Input

Filament Heaters

115 watts at 115 v., 50/60 cycles ac

Plate Supply

60 ma at 250 v. dc, ripple less than 0.030 volt

Input Impedance

Receiving Amplifier

22,000 ohms (From the baseband amplifier of the receiver/modulator unit)

Transmitting Amplifier

Multiplex: 600 ohms balanced (From the channelling equipment)

Service Channel: 100,000 ohms (From the service unit)

Input Level

Receiving Amplifier

Multiplex: 0.09 volt per channel

Service Channel: 0.08 volt

Transmitting Amplifier

Multiplex: —26 dbm per channel

Service Channel: 0.325 volt

Output Impedance

Receiving Amplifier

Multiplex: 600 ohms balanced (To the channelling equipment)

Service Channel: 6700 ohms (To the service unit)

Transmitting Amplifier

170 ohms (To the frequency modulator of the receiver/modulator unit)

Output Level

Receiving Amplifier

Multiplex: —10 dbm per channel

Service Channel: 0.61 volt

Transmitting Amplifier

Multiplex: 0.064 volt per low frequency channel

Service Channel: 0.057 volt

Tube Complement

Symbol	*Type*	*Function*
4V1	5965	Transmitting Baseband and Service Channel Amplifier
4V2	5965	Transmitting Cathode Follower/ Receiving Service Channel Amplifier
4V3	5965	Receiving Adding Amplifier
4V4	6CL6	Receiving Baseband Amplifier

Weight and Dimensions

Weight: 8 lbs.

Height: 3½ inches

Depth front of panel: 2½ inches

Depth back of panel: 4 inches

Width: 19 inches

DESCRIPTION

The baseband unit is designed for amplifying the signals passing to and from the channelling equipment (frequencies between 3 kc and 160 kc) and service unit (frequencies between 300 cps to 3 kc) at terminal and drop repeater stations.

The baseband unit amplifies the multiplex and service channel signals from the channelling equipment and service unit to the proper level and transfers them to the receiver/modulator units. It also amplifies the received signals (300 cps to 160 kc) from the receiver/modulator to the correct level before they are sent to the channelling equipment and service unit.

The baseband unit consists of two independent amplifier circuits. The transmitting amplifier (4V1 and 4V2A) feeds the multiplex and service channel signals to the receiver/modulator units. It has two inputs, one for the multiplex signals and the other for the service channel signals and two outputs, one for each receiver/modulator unit. The receiving amplifier (4V2B, 4V3 and 4V4) accepts the received signals and feeds them to the channelling equipment and the service unit. It has two inputs, one for each of the two possible receiver/modulator units and two outputs, one for the multiplex signals and the other for service channel signals.

There are two separate signal paths in the baseband unit. One path is from the multiplex signal input terminals 4J4-1-2 and the service channel input signal terminal 4J3-2, through the transmitting amplifier to output terminals 4J1-2 and 4J2-2. The transmitting amplifier is a two stage impedance coupled amplifier composed of 4V1 and 4V2A. The input stage utilizes a 5965 dual triode tube (4V1) which acts as an adding amplifier stage for the two separate inputs. A resistance-capacitance-inductance network in the plate circuit of 4V1 gives moderate pre-emphasis at the higher frequencies (approximately 5.9 db at 160 kc). The 3 kc to 160 kc signals from the channelling equipment are coupled through input transformer

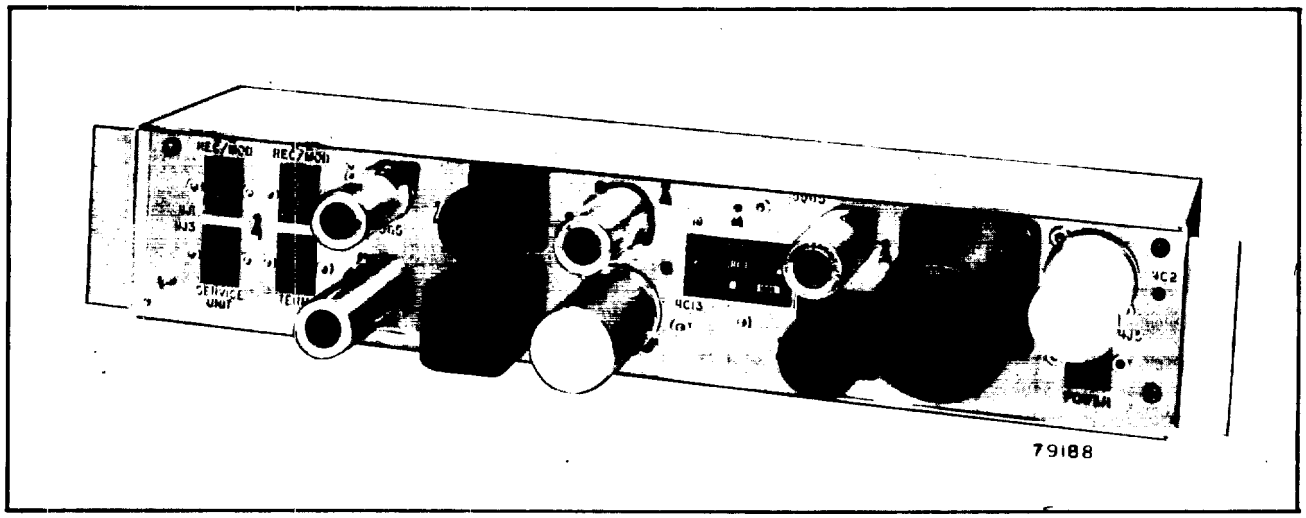


Figure B-1 — Baseband Unit — Front View

4T1 to the grid of the 1-2-3 section of 4V1. A 1 to 31 db attenuator (4AT1) is provided to set the signal level to amplifier 4V1 in order to obtain the correct output voltage at 4J1-2 and 4J2-2 to the receiver/modulator units. It contains individual pads of 1, 2, 4, 8 and 16 db loss which can be connected in cascade to give the desired attenuation. The service channel signals (300 cps to 3 kc) from the service unit are applied to the grid of the 6-7-8 section of 4V1. The output of 4V1 which contains both multiplex and service channel signals is applied to 4V2A. The output of cathode follower 4V2A is fed to the frequency modulator of the receiver/modulator units.

A second signal path is from 4J1-5 and 4J2-5, the input terminals for the received multiplex and service channel signals from the receiver/modulator units, through the receiving amplifier to the multiplex signal output terminals 4J4-5-6 and service channel output terminal 4J3-5. The receiving amplifier is a two stage resistance coupled amplifier composed of 4V2B, 4V3 and 4V4. It utilizes a separate output amplifier (4V4) for the multiplex signals and another output amplifier (4V2B) for the service channel signals. The input stage is a 5965 dual triode tube (4V3) which serves as an adding amplifier for the signal from the E-W and W-E receiver/modulators at a repeater station. From 4V3 the signals are applied to separate amplifiers 4V2B and 4V4. The amplifier for the service channel signals, 4V2B, contains an RC network which serves to attenuate the frequencies above 3000 cycles. The service channel signals (300 cps to 3 kc) in the output of 4V2B are fed to the service unit. The multiplex and service channel signals (300 cps to 160 kc) are amplified by 4V4 and delivered to the multiplex equipment through output transformer 4T2. A 1 to 15 db attenuator provides a means of setting the output of amplifier 4V4 to obtain the proper signal level of —10 dbm to the channelling equipment. The attenuator contains individual pads of 1, 2, 4 and 8 db loss which can be connected in cascade to give the desired attenuation. A 5 henry choke (4L2) is employed to shunt feed the plate of 4V4. Uniform high frequency response in both amplifier 4V3 and 4V4 is obtained by the use of peaking coils (4L3 and 4L4 respectively) in the plate circuit of each amplifier. Connections to the associated units including the power supply are made through interconnecting cables to Jones plugs on the front of the unit.

Attenuators 4AT1 and 4AT2

Connections to 4AT1 and 4AT2 are made at the factory and need not be changed thereafter. The individual pads are connected in cascade to obtain the required attenuation. Attenuator 4AT1 is connected between terminals 4J4-1-2 and 4T1-3-4. The required pads are connected together so that the output of the transmitting amplifier (at 4J1-2 and 4J2-2) is 0.064 volt to the frequency modulators of the receiver/modulator units for a low frequency channel. Attenuator 4AT2 is connected between terminals 4T2-3-4 and 4J4-5-6. The pads of this attenuator are connected so that the output of receiving amplifier 4V4 (at 4J4-5-6) to the channelling equipment is —10 dbm per channel.

MAINTENANCE

General Notes

1. Replace electrolytic capacitors 4C2 and 4C13 once a year.

2. The tubes seldom need replacing. The circuits employed allow the tubes to deteriorate appreciably before a change in gain is noticeable. However the gain of the unit should be checked as described under *Voltage Gain Check* at yearly intervals and also if, after changing tubes, the gain of the amplifiers is still outside the stated tolerance.

3. Excessive intermodulation distortion can usually be remedied by replacing tubes. If this fails to reduce the distortion, socket voltages and resistor values should be checked.

Voltage Gain Check

To check the voltage gain of the baseband unit use the following procedure. Before performing the check disconnect the cables from plugs 4J1, 4J2, 4J3, and 4J4. This removes the signal sources from the unit and allows the system to remain in operation while the measurements are being made. Make sure that there is no system traffic through the baseband unit before removing the plugs. Make all audio voltage measurements with a Ballantine Model 310A voltmeter (or equivalent) and use a Hewlett Packard Type 200CD audio oscillator (or equivalent) to generate the test tones.

Transmitting Amplifier

Baseband Input

1. Connect the audio voltmeter to 4J2-2.

2. Apply a 0.038 volt, 5 kc tone to 4T1-3-4.

3. The meter reading at 4J2-2 should be 0.19 volt ± 1db.

4. Connect the audio voltmeter to 4J1-2 and repeat step 2.

5. The meter reading at 4J1-2 should be 0.19 volt ± 1.0 db.

Service Channel Input

1. Apply a 0.325 volt, 1000 cycle tone to 4J3-2.

2. The meter reading at 4J2-2 should be 0.057 volt ± 0.5 db.

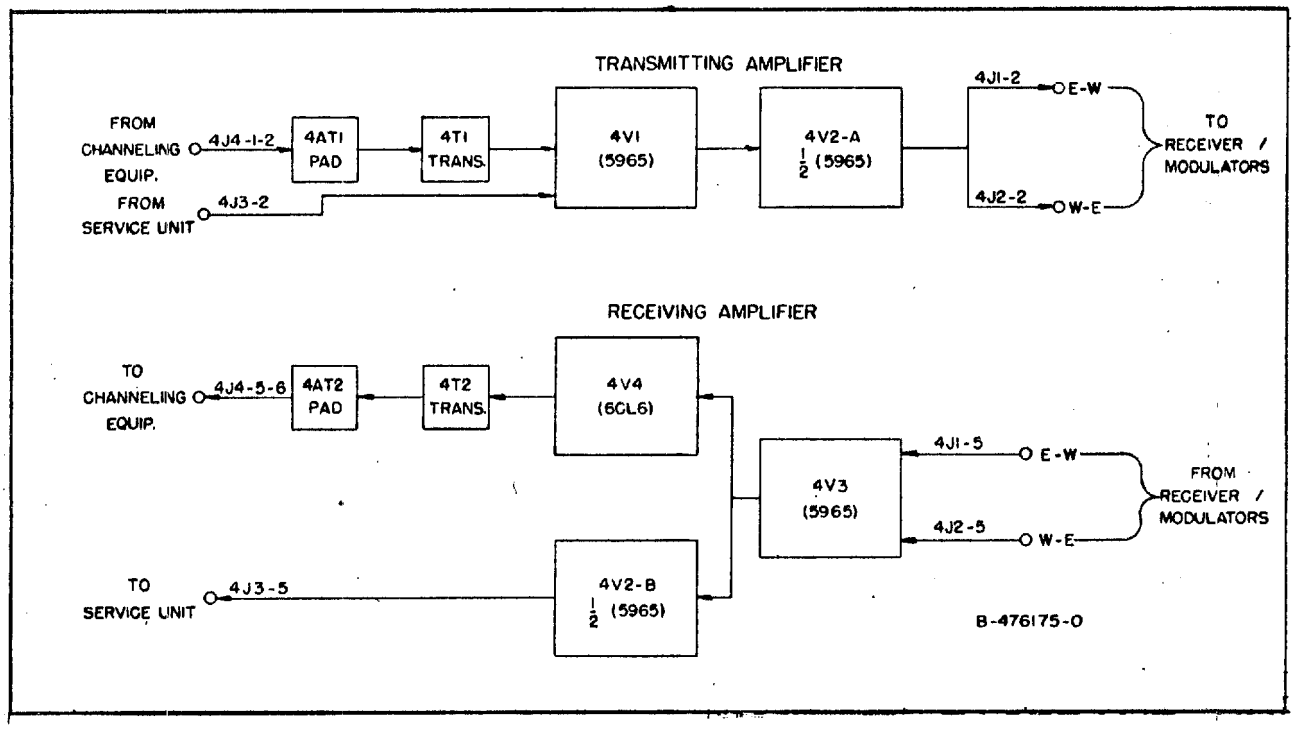


Figure B-2 — Baseband Unit — Block Diagram

Receiving Amplifier

Baseband Output

1. Connect the audio voltmeter to 4T2-3-4 and terminate with 4J4-5-6 with 600 ohms.

2. Apply a 0.090 volt, 5 kc tone alternately to 4J1-5 and 4J2-5.

3. The meter reading at 4T2-3-4 should be 0.345 volts ± 1.0 db with the tone applied at either 4J1-5 or 4J2-5.

NOTE: This figure applies for the standard level setting (4C14 connected to the junction of 4R34 and 4R35). In systems in which 4C14 is connected to the plates of 4V3 a meter reading of 0.69 volts ± 1.0 db should be obtained.

Service Channel Output

1. Connect the audio voltmeter to 4J3-5 and terminate with 3400 ohms.

2. Apply a 0.080 volt, 1000 cycle tone alternately to 4J1-5 and 4J2-5.

3. The meter reading at 4J3-5 should be 0.61 volt ± 0.5 db with the tone applied at either 4J1-5 or 4J2-5.

After completing the check remove the test equipment and terminating resistors, and reconnect the cables to plugs 4J1, 4J2, 4J3 and 4J4.

Frequency Response Check

To check the frequency response of the baseband unit, follow the procedure described below. Before performing the check make sure there is no system traffic through the baseband unit. Disconnect the cables from plugs 4J1, 4J2, 4J3, and 4J4. This removes the signal sources from the unit and allows the system to remain in operation while the measurements are being made. Make all audio voltage measurements with a Ballantine Model 310A audio voltmeter (or equivalent) and use a Hewlett Packard Type 200 CD audio oscillator (or equivalent) as the test tone source.

Transmitting Amplifier

Baseband Input

1. Connect the audio voltmeter to 4J2-2.

2. Apply the test frequencies listed in step #3 below to 4J4-1-2 through a 600 ohm series resistor. Keep the oscillator output constant at 0.2 volt measured at the oscillator terminals.

3. Measure the output at the test frequencies at 4J2-2. With the 10 kc output as a 0 db reference the readings must be within the following limits:

Frequency (kc)	*Nominal (db)*	*Tolerance (db)*
0.3	—0.4	± 0.2
0.5	—0.4	± 0.2
1.0	—0.4	± 0.1
2.0	—0.4	± 0.1
5.0	—0.2	± 0.1
10	0.0	± 0.0
20	0.7	± 0.1
50	2.6	± 0.2
100	4.1	± 0.2
160	5.9	± 0.3

Receiving Amplifier

Baseband Output

1. Connect the audio voltmeter to 4J4-5-6 and terminate with 600 ohms.

2. Apply the set of test frequencies listed below first to 4J1-5 and then to 4J2-5 and measure the output at 4J4-5-6. Keep the oscillator output constant at 0.10 volt at all frequencies. Make a separate check for each test input (4J1-5 and 4J2-5). With the 10 kc output as a 0 db reference the readings must be within the following limits:

Frequency (kc)	*Nominal (db)*	*Tolerance (db)*
0.3	0.4	± 0.2
0.5	0.2	± 0.2
1.0	0.0	± 0.2
2.0	0.0	± 0.1
5.0	0.0	± 0.1
10	0.0	± 0.0
10	0.0	± 0.1
50	0.0	±0.2
100	0.0	± 0.2
160	0.0	± 0.3

Service Channel Output

1. Connect the audio voltmeter to 4J3-5 and terminate with 3400 ohms.

2. Apply the test frequencies listed in step #3 below to 4J1-5: Keep the oscillator output constant at 0.080 volt for all frequencies.

3. Measure the output at the above frequencies at 4J3-5. With the 1000 cycle output as a 0 db reference the readings must be within the following limits:

Frequency (kc)	*Nominal (db)*	*Tolerance (db)*
0.3	—0.6	±0.2
0.5	—0.1	±0.1
1.0	0.0	±0.0
2.0	—0.5	±0.2
3.0	—1.5	±0.3
5.0	—3.5	±0.6
10	—8.5	±1.0
20	—16.0	±2.0
100	—40.0	±5.0

After completing the check remove the test equipment and terminating resistors and reconnect the cables to plugs 4J1, 4J2, 4J3 and 4J4.

TYPICAL BASEBAND UNIT VOLTAGES

The following are typical voltages existing between individual tube pins and ground as measured with an RCA voltohmyst WV97A. All readings are dc unless otherwise specified.

Tube	*Type*	*Pin 1*	*Pin 2*	*Pin 3*	*Pin 4*	*Pin 5*	*Pin 6*	*Pin 7*	*Pin 8*	*Pin 9*
4V1	5965	188	7.3	10	0	0	168	6.4	8.7	6.0 ac
4V2	5965	239	64	96	0	0	163	0	1.95	6.0 ac
4V3	5965	122	7.0	8.7	0	0	122	7.0	8.7	6.0 ac
4V4	6CL6	13.4	9.1	162	0	6.0 ac	228	13.4	162	9.1

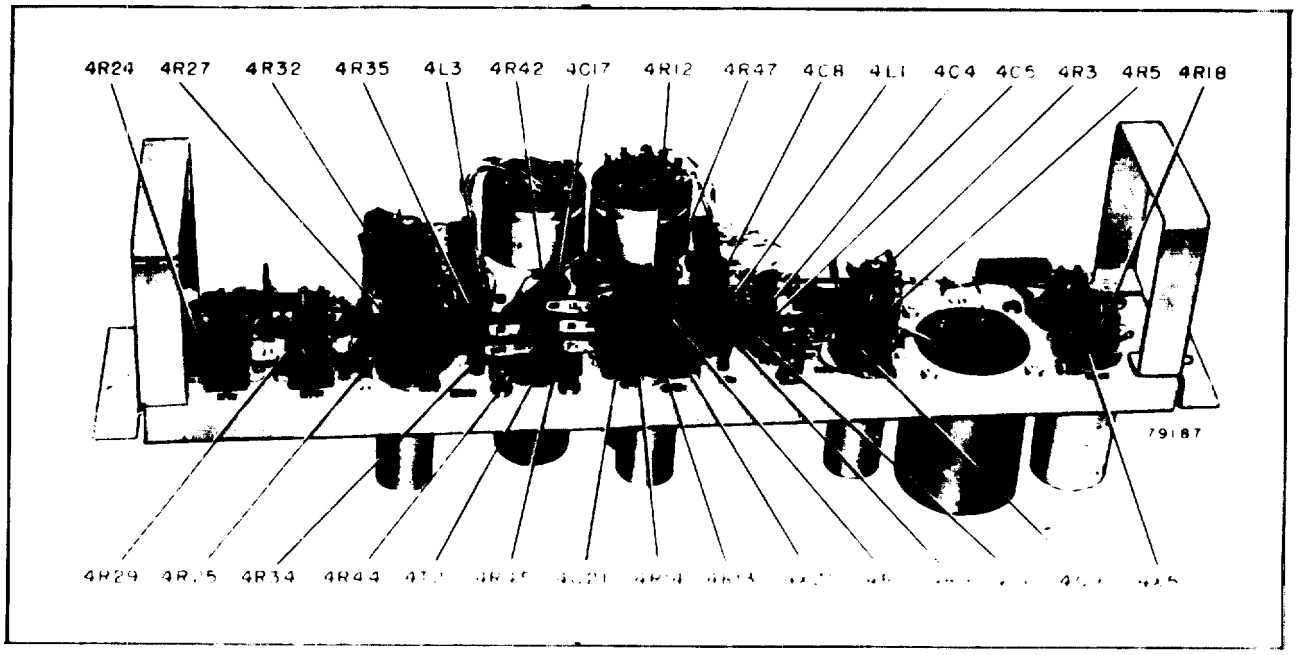


Figure B-3 — Baseband Unit — Rear View, Dust Cover Removed

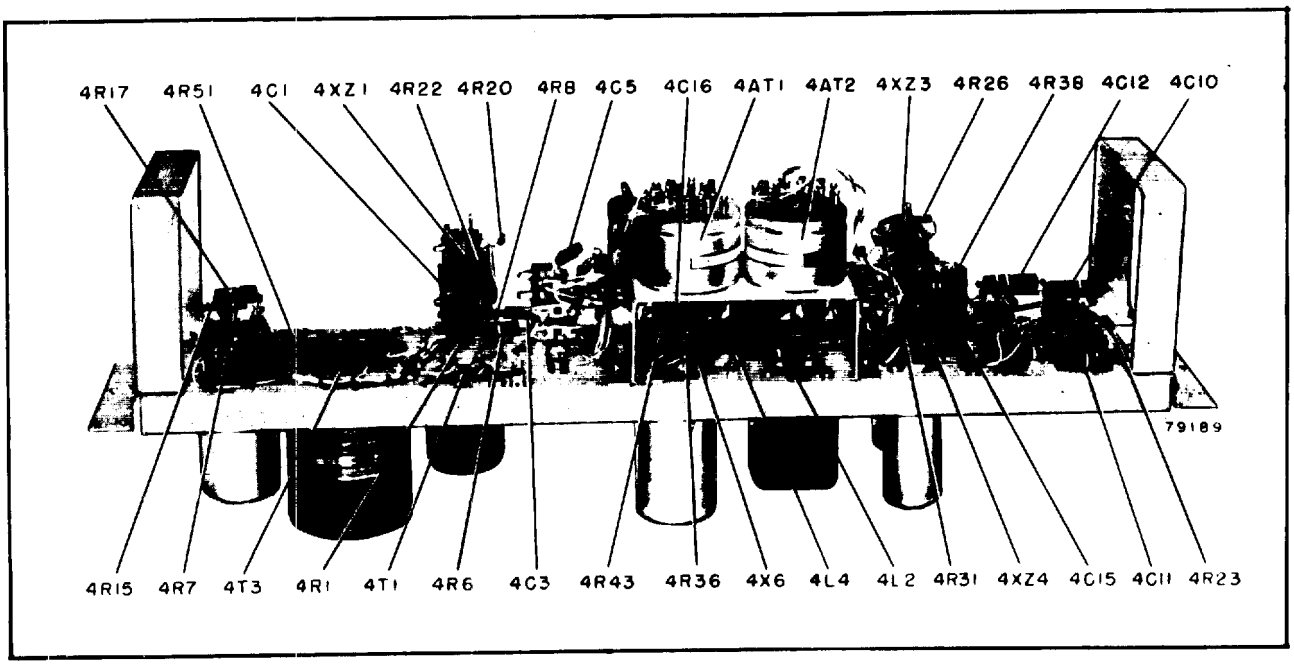


Figure B-4 — Baseband Unit — Rear View, Dust Cover Removed

REPLACEMENT PARTS LIST

Symbol No.	*Description*	*Drawing No.*	*Stock No.*
4AT1	Resistor, attenuator, fixed, attenuation steps to be 1, 2, 4, 8, 16 db, input and output impedance 600 ohm each step	8902728-1	207041
4AT2	Resistor, attenuator, fixed attenuation steps to be 1, 2, 4, 8 db, input and output impedance 600 ohm each step	8902717-1	207042
4C1	Capacitor, fixed, paper, 0.01 mf ±10%, 400 v	735715-163	73561
4C2A/B/C	Capacitor, dry electrolytic, 10/10/10 mf +50 −10%, 450/450/450 v	449618-1	56304
4C3	Capacitor, fixed, mica, 100 mmf ±2%, 500 v	727853-323	207043
4C4	Capacitor, fixed, paper, 0.033 mf ±10%, 400 v	735715-169	73552
4C5	Capacitor, fixed, mica, 22 mmf ±5%, 500 v	748252-315	96998
4C6	Capacitor, fixed, mica, 120 mmf ±2%, 500 v	727853-325	204941
4C7	Capacitor, fixed, paper, 0.01 mf ±10%, 400 v. same as 4C1	735715-163	73561
4C8	Capacitor, fixed, paper, 0.22 mf ±10%, 200 v	735715-79	73794
4C9	Capacitor, fixed, paper, 0.047 mf ±10%, 400 v (part of 4XZ1)	735715-171	73553
4C10 to 4C12	Capacitor, fixed, paper, 0.01 mf ±10%, 400 v. same as 4C1	735715-163	73561
4C13A/B/C	Capacitor, dry electrolytic, 10/10/10 mf +50% −10%, 450/450/450 v. same as 4C2A/B/C	449618-1	56304
4C14	Capacitor, fixed, paper, 0.01 mf ±10%, 400 v. same as 4C1 (part of 4XZ4)	735715-163	73561
4C15	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v (part of 4XZ4)	735715-175	73551
4C16	Capacitor, fixed, paper, 0.068 mf ±10%, 200 v	735715-73	73792
4C17	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v. same as 4C15	735715-175	73551
4C18, 4C19	Capacitor, fixed, mica, 47 mmf ±5%, 500 v	748252-323	95320
4C20	Capacitor, fixed, paper, 0.01 mf ±10%, 400 v. same as 4C1	735715-163	73561
4C21	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v. same as 4C15	735715-175	73551
4J1, 4J2	Connector, male, 6 contact, chassis mtg.	181494-3	28507
4J3, 4J4	Connector, female, 6 contact, chassis mtg.	181494-4	18534
4J5	Connector, male, 6 contact, chassis mtg. same as 4J1	181494-3	28507
4L1	Reactor, r-f choke 5.5 millihenry ±5%	8819013-503	207044
4L2	Reactor, filter choke, 5 henry	949732-2	205032
4L3	Reactor, r-f choke, 3.5 millihenry ±5%	8819013-502	207045

Symbol No.	Description	Drawing No.	Stock No.
4L4	Reactor, r-f choke 5.5 millihenry ±5%. same as 4L1	8819013-503	207044
4R1	Resistor, fixed, composition, 10,000 ohm ±5%, ½ w	735730-183	502310
4R2	Resistor, fixed, composition, 1000 ohm ±10%, ½ w (part of 4XZ1)	735730-62	502210
4R3	Resistor, fixed, composition, 270,000 ohm ±10%, ½ w (part of 4XZ1)	735730-91	502427
4R4	Resistor, fixed, composition, 270 ohm ±5%, ½ w (part of 4XZ1)	735730-145	502127
4R5	Resistor, fixed, composition, 1000 ohm ±5%, ½ w (part of 4XZ1)	735730-159	502210
4R6	Resistor, fixed, composition, 6800 ohm ±5%, 1 w	90496-179	512268
4R7	Resistor, fixed, composition, 1000 ohm ±10%, ½ w. same as 4R2	735730-62	502210
4R8	Resistor, fixed, carbon film, 56,200 ohm ±1%, ½ w	990185-473	207046
4R9	Resistor, fixed, carbon film, 35,700 ohm ±1%, ½ w	990185-454	207047
4R10	Resistor, fixed, composition, 56,000 ohm ±5%, ½ w	735730-201	502356
4R11	Resistor, fixed, composition, 1000 ohm ±10%, ½ w. same as 4R2 (part of 4XZ2)	735730-62	502210
4R12	Resistor, fixed, composition, 270,000 ohm ±10%, ½ w. same as 4R3 (part of 4XZ2)	735730-91	502427
4R13	Resistor, fixed, composition, 270 ohm ±5%, ½ w. same as 4R4 (part of 4XZ2)	735730-145	502127
4R14	Resistor, fixed, composition 15,000 ±5%, 2 w (part of 4XZ2)	99126-187	522315
4R15	Resistor, fixed, composition, 2200 ohm ±10%, ½ w	735730-66	502222
4R16	Resistor, fixed, composition, 56,000 ohm ±5%, ½ w. same as 4R10 (part of 4XZ1)	735730-201	502356
4R17	Resistor, fixed, composition, 10,000 ohm ±5%, 2 w	99126-183	522310
4R18	Resistor, fixed, composition, 1000 ohm ±10%, ½ w. same as 4R2	735730-62	502210
4R19	Resistor, fixed, composition, 1000 ohm ±10%, ½ w. same as 4R2 (part of 4XZ1)	735730-62	502210
4R20	Resistor, fixed, composition, 270,000 ohm ±10%, ½ w. same as 4R3 (part of 4XZ1)	735730-91	502427
4R21	Resistor, fixed, composition, 270 ohm ±5%, ½ w. same as 4R4 (part of 4XZ1)	735730-145	502127
4R22	Resistor, fixed, composition, 1000 ohm ±5%, ½ w. same as 4R5 (part of 4XZ1)	735730-159	502210
4R23	Resistor, fixed, composition, 100,000 ohm ±10%, ½ w	735730-86	502410
4R24	Resistor, fixed, composition, 22,000 ohm ±5%, ½ w	735730-191	502322
4R25	Resistor, fixed, composition, 1000 ohm ±10%, ½ w. same as 4R2 (part of 4XZ3)	735730-62	502210
4R26	Resistor, fixed, composition, 270,000 ohm ±10%, ½ w same as 4R3 (part of 4XZ3)	735730-91	502427
4R27	Resistor, fixed, composition, 150 ohm ±5%, ½ w. (part of 4XZ3)	735730-139	502115
4R28	Resistor, fixed, composition, 1200 ohm ±5%, ½ w (part of 4XZ3)	735730-161	502212
4R29	Resistor, fixed, composition, 22,000 ohm ±5%, ½ w. same as 4R24	735730-191	502322
4R30	Resistor, fixed, composition, 1000 ohm ±10%, ½ w. same as 4R2 (part of 4XZ3)	735730-62	502210
4R31	Resistor, fixed, composition, 270,000 ohm ±10%, ½ w. same as 4R3 part of 4XZ3)	735730-91	502427
4R32	Resistor, fixed, composition, 150 ohm ±5%, ½ w. same as 4R27 (part of 4XZ3)	735730-139	502115
4R33	Resistor, fixed, composition, 1200 ohm ±5%, ½ w. same as 4R28 (part of 4XZ3)	735730-161	502212
4R34, 4R35	Resistor, fixed, composition, 4700 ohm ±5%, 1 w	90496-175	512247
4R36	Resistor, fixed, composition, 1000 ohm ±10%, ½ w. same as 4R2	735730-62	502210
4R37	Resistor, fixed, composition, 1000 ohm ±10%, ½ w. same as 4R2 (part of 4XZ4)	735730-62	502210
4R38	Resistor, fixed, composition, 270,000 ohm ±10% ½ w. same as 4R3 (part of 4XZ4)	735730-91	502427
4R39	Resistor, fixed, composition, 180 ohm ±5%, ½ w (part of 4XZ4)	735730-141	502118
4R40	Resistor, fixed, composition, 470 ohm ±5%, ½ w (part of 4XZ4)	735730-151	502147
4R41	Resistor, fixed, composition, 18,000 ohm ±5%, 2 w. (part of 4XZ4)	99126-189	522318
4R42	Resistor, fixed, composition, 10,000 ohm ±5%, ½ w. same as 4R1	735730-183	502310
4R43	Resistor, fixed, composition, 1000 ohm ±10%, 2 w	99126-62	522210
4R44, 4R45	Resistor, fixed, composition, 470,000 ohm ±5%, ½ w	735730-223	502447

Symbol No.	Description	Drawing No.	Stock No.
4R46	Resistor, fixed, composition, 1000 ohm ±10%, ½ w. same as 4R2 (part of 4XZ2)	735730-62	502210
4R47	Resistor, fixed, composition, 470,000 ohm ±5%, ½ w. same as 4R44 (part of 4XZ2)	735730-223	502447
4R48	Resistor, fixed, composition, 270 ohm ±5%, ½ w. same as 4R4 (part of 4XZ2)	735730-145	502127
4R49	Resistor, fixed, composition, 1000 ohm ±10%, ½ w. same as 4R2	735730-62	502210
4R50	Resistor, fixed, composition, 10,000 ohm ±5%, 2 w. same as 4R17 (part of 4XZ2)	99126-183	522310
4R51	Resistor, fixed, wire wound, 80 ohm ±5%, 5 w	458572-22	207048
4T1, 4T2	Transformer, wideband; freq. response 300 cps to 160 kc, impedance ratio 16.6:1	949779-1	207049
4T3	Transformer, filament	949385-1	94196
4X1	Socket, tube, 9 pin miniature, 2-3/32 overall including turret (part of 4XZ1)	742413-4	205034
4X2	Socket, tube, 9 pin miniature, 2-3/32 overall including turret (part of 4XZ2) same as 4X1	742413-4	205034
4X3	Socket, tube, 9 pin miniature, 2-3/32 overall including turret (part of 4XZ3) same as 4X1	742413-4	205034
4X4	Socket, tube, 9 pin miniature, 2-3/32 overall including turret (part of 4XZ4) same as 4X1	742413-4	205034
4X5, 4X6	Socket, tube, octal, saddle mounted, red phenolic insulation	99100-7	207594
4XZ1	Socket Assembly, not stocked complete, parts only available	635967-503	
4XZ2	Socket Assembly, not stocked complete, parts only available	635967-504	
4XZ3	Socket Assembly, not stocked complete, parts only available	635967-501	
4XZ4	Socket Assembly, not stocked complete, parts only available	635967-502	
	Miscellaneous		
	Base, tube shield for 4XZ1, 4XZ2, 4XZ3, 4XZ4	742413-3	205036
	Shield, tube, 9 pin miniature, 1-15/16" lg., for 4XV1, 4XV2, 4XV3	8888549-2	56359
	Shield, tube, 9 pin miniature, 2⅜" lg., for 4XV4	8888549-3	205035

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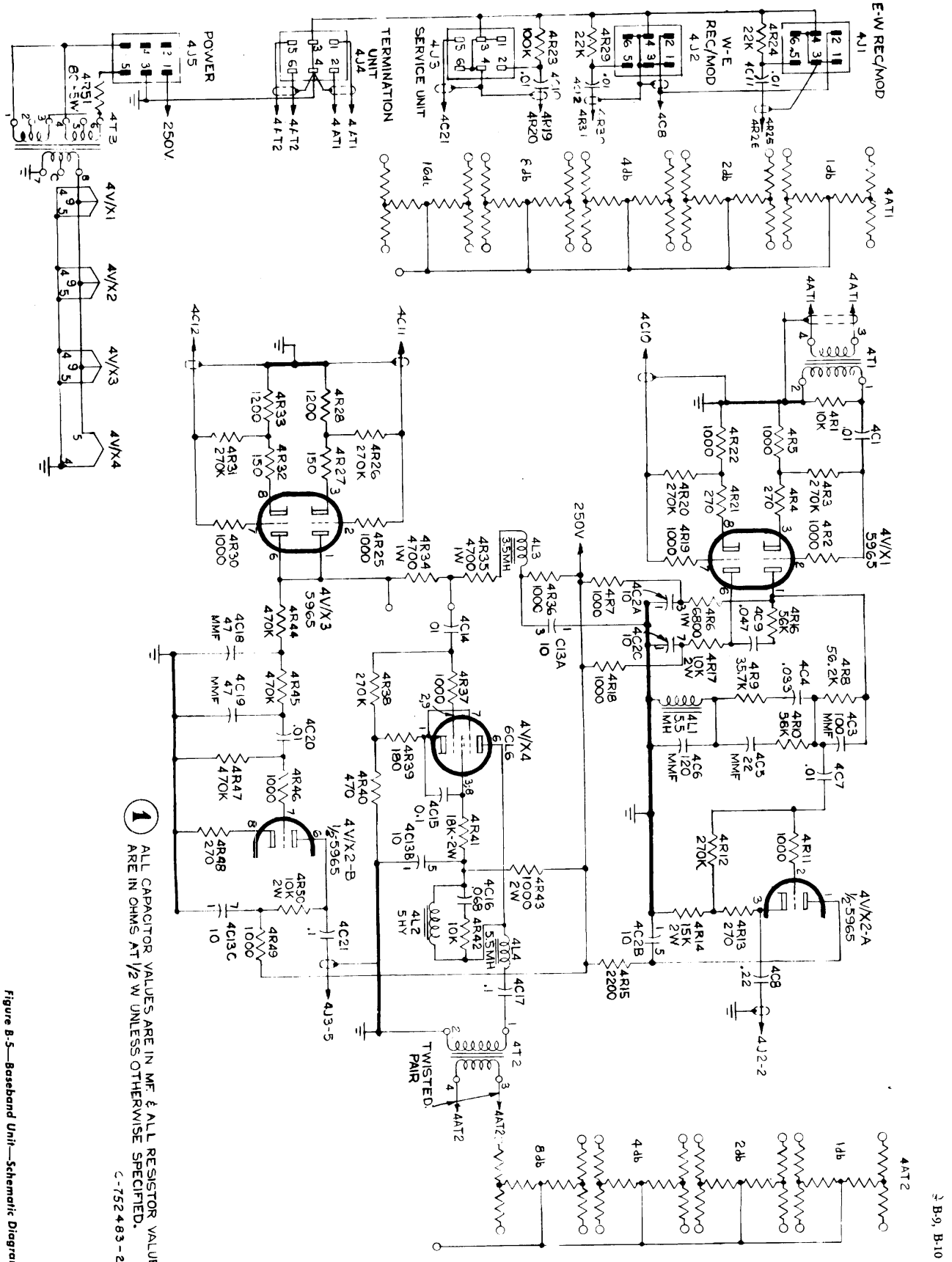
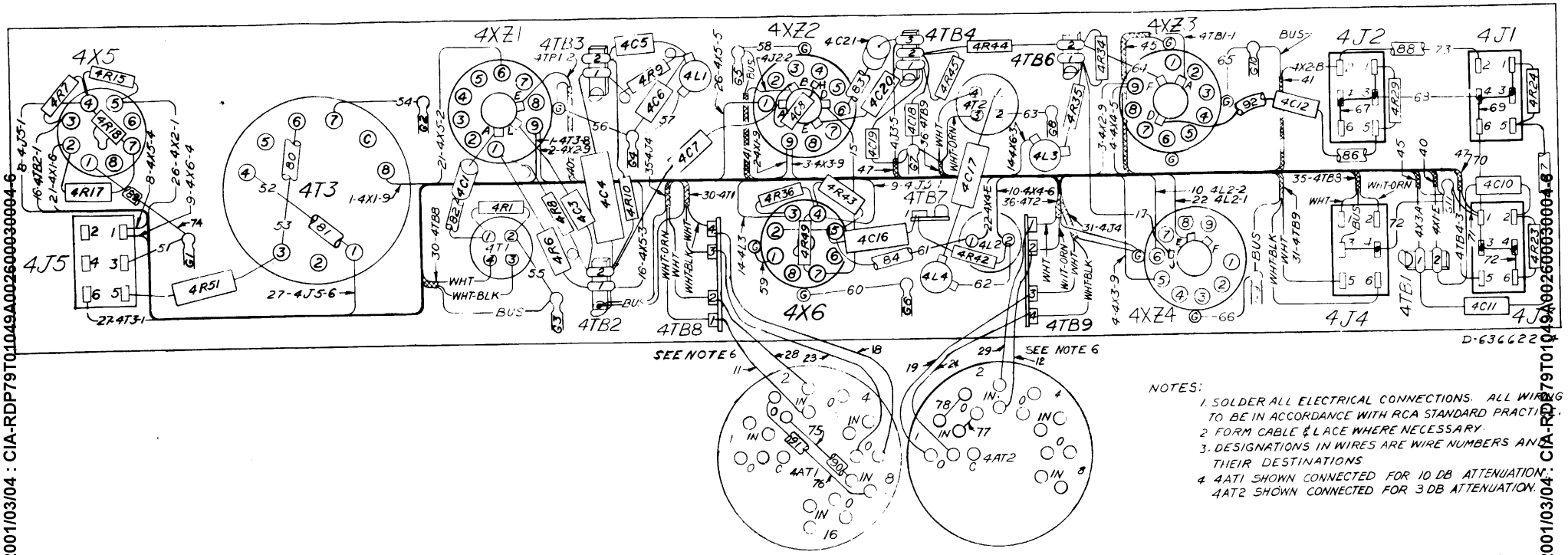


Figure B-5—Baseband Unit—Schematic Diagram

↳ B-9, B-10



NOTES:

1. SOLDER ALL ELECTRICAL CONNECTIONS. ALL WIRING TO BE IN ACCORDANCE WITH RCA STANDARD PRACTICE.
2. FORM CABLE & LACE WHERE NECESSARY.
3. DESIGNATIONS IN WIRES ARE WIRE NUMBERS AND THEIR DESTINATIONS.
4. 4AT1 SHOWN CONNECTED FOR 10 DB ATTENUATION. 4AT2 SHOWN CONNECTED FOR 3 DB ATTENUATION.

WIRE TABLE		8900590		
WIRE NO (INCLUSIVE)	DESCRIPTION COLOR & CONDUCTOR	PS NUMBER OR DRAWING NO.	PARTS LIST ITEM NO.	WIRE NOS NOT USED
1 TO 7	WHT-BRN 16/.010	PS-724-9	38	
8 TO 14	-RED 7/.010	PS-724-1	39	
14 TO 20	-GRN		40	
21 TO 26	-BLU		41	
26 TO 30	WHT-BLK 7/.010	PS-724-1	42	
30, 31	WHT, WHT-BLK SHIELDED PR	8831001-1	43	
35, 36	WHT-BLK, WHT-ORN SHIELDED PR.	8831001-3	44	
40, 41	WHT (SHIELDED) 7/.010	8845679-1	45	
45	WHT-BRN(SHIELDED) 7/.010	8845679-2	46	
47	WHT-RED(SHIELDED) 7/.010	8845679-3	47	
51 TO 78	TINNED COPPER WIRE .032 D.	PS105	48	
80 TO 92	BLACK INSTUBING .042 I.D	PS 8	49	

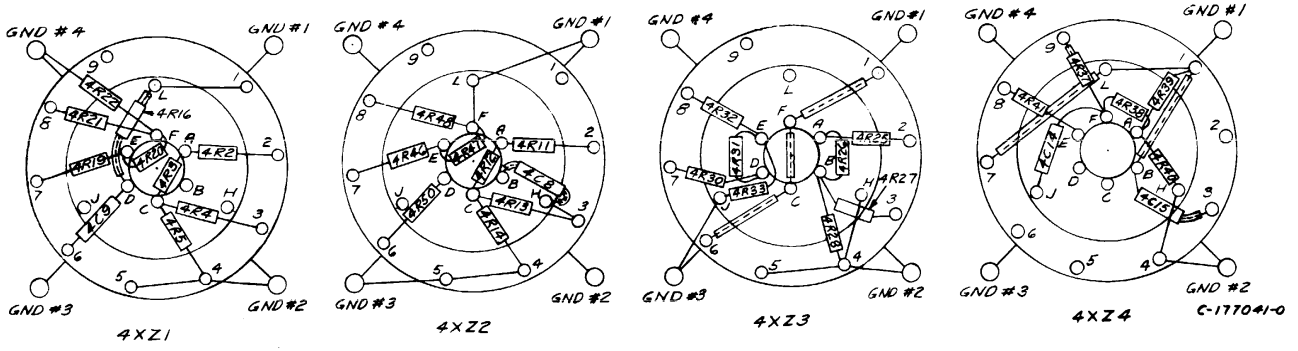


Figure B-6 — Baseband Unit — Wiring Diagram

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H

MICROWAVE COMMUNICATION EQUIPMENT

Transmitter MI-31132-1

- TECHNICAL DATA
- DESCRIPTION
- MAINTENANCE
- REPLACEMENT PARTS

RADIO CORPORATION OF AMERICA
COMMERCIAL ELECTRONIC PRODUCTS, CAMDEN, N. J.

Printed In U.S.A.
DU 566-5

IB-33241-1

TECHNICAL DATA

Power Input:
a. Fil. Heaters and Blower. 95 watts at 115 volts—50/60 cycle A.C.
b. Plate Supply: 65 milliamps at 250 v dc
300 milliamps at 500 v dc

Frequency Range
1700-1990 megacycles

Modulated Signal Input
70 megacycle FM Signal from the receiver/modulator unit

R-F Bandwidth
8 mc

Peak Carrier Deviation
±1.5 megacycles

Transmitter Power Output
3 watts

Crystal

Symbol	*Type*	*Function*
1CR1	1N21B	RF Rectifier
1CR2	1N48	RF Rectifier

Tube Complement

Symbol	*Type*	*Function*
1V1	12AT7	DC Amplifier
1V2	2C39A	Local Oscillator
1V3	2C39A	Transmitter Mixer
1V4	2C39A	RF Amplifier
1V5	6CL6	70 mc i-f Amplifier
1V6	2E26	70 mc i-f Amplifier
1V7	35C5	Osc. Cathode Current Regulator

Fuse Complement

Symbol	*Type*	*Function*
1F1	MJB 1/32 amp	Arc Indicator
1F2	MJB 1/32 amp	Arc Indicator
1F3	MJB 1/32 amp	Arc Indicator

Weight and Dimensions
Weight—25 lbs.
Height—10½"
Depth back of panel: (6" plus 1" allowance for air passage. 11" with air filter)
Depth front of panel: 4"
Width: 19" Rack Mounting

DESCRIPTION

This Transmitter Unit is designed for installation in either a standard 19" open rack or cabinet and is used in both terminal and repeater stations. It provides a frequency modulated r-f output in the frequency range of 1700 to 1990 mc.

The transmitter unit contains the equipment to generate and amplify the microwave carrier. The oscillator frequency is determined by tuning resonant cavity 1Z1A by means of the top left tuning screw. (This and the three other cavity tuning screws are located on the cavity assembly mounted on the front panel.) This frequency is coupled directly to the mixer cathode resonant cavity 1Z1B which is tuned by the lower left tuning screw. The oscillator frequency is mixed with the 70 mc carrier from the modulator section of the receiver/-modulator unit. This 70 mc frequency modulated signal is injected into the cathode circuit of mixer tube 1V3. The resultant frequency, the sum or difference in accordance with the system plan, is fed thru mixer anode tuning cavity 1Z1C to the r-f amplifier 1V4. 1Z1C is tuned to the output frequency of the mixer stage by the upper right cavity tuning screw. The r-f amplifier stage is tuned to the same frequency as the mixer output. This tuning is done in resonant cavity 1Z1D by the lower right cavity tuning screw. (All cavity tuning screws are turned out for an increase in frequency).

The plate tuning cavity 1Z1D of the r-f amplifier contains three pickup devices. The one connected to jack 1J2 absorbs a comparison sample for the terminal AFC unit. A loop transfers to 1J3 the r-f energy for the antenna. A slot is used to obtain energy to operate r-f monitor 1M2, the combination output meter and fault relay.

Seventy mc amplifier stages 1V5 and 1V6 amplify the 70 mc signal from the receiver/modulator to raise it to the proper amplitude before injection into the transmitter mixer circuit.

R-f monitor 1M2 is an r-f output indicating meter which also acts as the transmitter fault indicating device. The r-f energy for operating 1M2 is rectified by crystal 1N21B in cavity 1Z1D. MONITOR ADJUST 1R14 controls the amount of current flowing through 1M2 to keep the meter pointer on scale. When the output of r-f amplifier 1V4 drops to a certain predetermined value a circuit is closed inside 1M2 which energizes a transmitter fault reporting relay in the service unit. The value at which the 1M2 relay reports a fault is in-

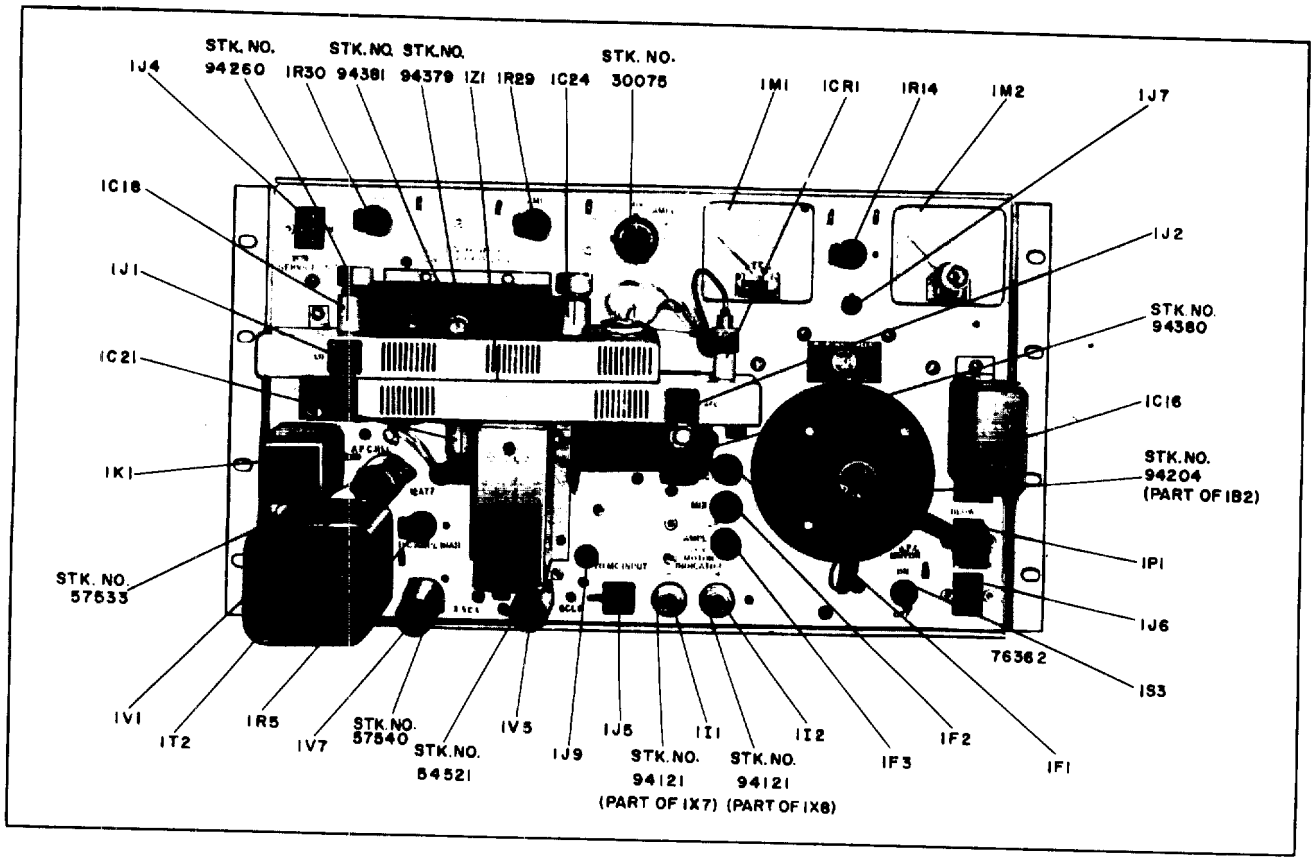


Figure T-1—Transmitter—Front View

dicated by the red pointer which can be set manually by a control knob on the front of 1M2.

DC amplifier 1V1, relay 1K1 and AFC motor 1B1 and associated circuits constitute the transmitter oscillator frequency control section. The following is the sequence of events that cause this equipment to function: A portion of the transmitter local oscillator output is coupled by a cable, attached to jack 1J1, to the receiver r-f mixer in the receiver/-modulator unit. The transmitter oscillator frequency and the received microwave frequency determines the receiver 30 mc i-f. If the transmitter local oscillator drifts the resultant change in the receiver i-f causes a dc component to appear in the receiver 30 mc discriminator output. This dc is carried through the service unit to the transmitter jack 1J4 of the transmitter. From terminal 1 of jack 1J4 it is applied to the control grid of the 1-2-3 section of dc amplifier 12AT7 (1V1).

When the transmitter operates on the sideband above the L.O. (local oscillator) frequency, the connections to motor 1B1 are as shown in figures T-3 and T-4. (Motor 1B1 is actually two motors mounted on a single shaft. The F and B terminals shown on the schematic are the power connections to the "front" (F) and "back" (B) motors of 1B1. The "front" motor refers to the one nearest the panel.) Contact 7 of relay 1K1 is connected to the F terminal of 1B1 and contact 4 of 1K1 is connected to the B terminal of 1B1. If the receiver i-f increases for any reason, a positive dc voltage at 1V1-2 from the receiver discriminator will cause relay 1K1 to function so that 1B1 runs in a counterclockwise direction as indicated by the lighting of the + (1I2) lamp. This will turn the tuning loop in cavity 1Z1A to increase the L.O. frequency so that the receiver i-f is again 30 mc. A decrease of receiver i-f causes a negative dc voltage at 1V1-2 which will move the tuning loop in a clockwise direction, as indicated by the lighting of the – (1I1) lamp, and decrease the L.O. frequency so that the receiver i-f is again 30 mc.

For lower sideband transmitter operation the connections to 1B1 are: contact 7 of relay 1K1 is connected to the B terminal of 1B1 and contact 4 of 1K1 is connected to the F terminal of 1B1. When 1B1 is connected in this manner a positive dc voltage at 1V1-2, caused by a receiver i-f increase, will

cause the 1Z1A tuning loop to turn in a clockwise direction and light the + (1I2) lamp. This will decrease the L.O. frequency until the receiver i-f is again 30 mc. A negative voltage at 1V1-2 caused by a receiver i-f decrease will cause the 1Z1A tuning loop to turn in a counterclockwise direction and light the – (1I1) lamp. This will increase the L.O. frequency until the receiver i-f is again 30 mc. The dc amplifier bias control 1R5 is adjusted so that when the receiver discriminator dc output is at zero voltage the AFC motor 1B1 stops running.

In order to prevent the AFC motor 1B1 from moving the tuning loop out of position during initial installation or when servicing the station equipment, an AFC motor disabling switch has been provided. With the AFC Motor switch 1S3 open (OFF) the 115 v ac to 1B1 is disconnected.

Meter Switch 1S1A in conjunction with test meter 1M1 supplies a means of making the following measurements: On the 250 and 500 positions of 1S1A, meter 1M1 registers the two B+ voltages from the power supply. On the OSC, MIX and AMPL positions of 1S1A, 1M1 measures the cathode current of the oscillator 1V2, mixer 1V3, and RF amplifier 1V4 respectively. The + and – positions of 1S1A are used when positive and negative external voltage readings are made in this and other units by means of a test lead.

The transmitter oscillator, mixer and r-f amplifier tubes are cooled by blower 1B2 and if for any reason the blower should stop, the air operated switch 1S2 breaks the ac power to their filament transformer to prevent these tubes from overheating.

The plate circuit of tubes 1V2, 1V3 and 1V4 each contain a series combination of a $\frac{1}{32}$ amp. fuse and 150 ohm resistor in parallel with the 50 ohm damping resistor. Should arc-over occur in any of these tubes, evidence of this will be indicated by a blown 5F16 fuse in the power supply. The faulty tube may readily be detected by checking each of the arc indicating fuses 1F1 (OSC), 1F2 (MIXER) and 1F3 (AMPL.).

The cathode current of the oscillator 1V2 contains a 35C5 ballast tube. This is a current regulating device which prevents the cathode current of 1V2 from varying greatly from the value set by 1R30. If the cathode current of 1V2 tends to increase or decrease appreciably the resistance of the filament of 1V7 will increase and decrease accordingly to maintain the current through it at a nearly constant value.

CONTROLS

a. The Local Oscillator Tuning Screw (Upper left) of cavity 1Z1A varies the resonant frequency of the plate circuit cavity and so determines the frequency of the oscillator. (Turning the screw out increases the resonant frequency of the cavity. This applies to all four of the transmitter cavity tuning screws.)

b. The Local Oscillator Cathode Tuning Screw (Lower left) of cavity 1Z1B varies the resonant frequency of the cathode cavity of the local oscillator and mixer cathode circuits. This tuning control has only a negligible effect on the oscillator frequency.

c. The Mixer Plate Tuning Screw (Upper right) of cavity 1Z1C varies the resonant frequency of the mixer tuning cavity. It is tuned either to the local oscillator frequency plus the 70 mc i-f carrier or to the local oscillator frequency minus the 70 mc i-f carrier in accordance with the system plan.

d. The RF Amplifier Tuning Screw (Lower right) of the cavity 1Z1D varies the resonant frequency of the plate tuning cavity. It is tuned to the mixer output frequency.

e. The OSC control (1R30) is a screwdriver adjusted potentiometer which controls the cathode current of the oscillator tube 1V2 by varying its cathode bias.

f. The AMPL control (1R29) is a screwdriver adjusted potentiometer which controls the cathode current of the r-f amplifier tube 1V4 by varying its cathode bias.

g. The MONITOR ADJUST control (1R14) is a screwdriver adjusted potentiometer that controls the amount of rectified r-f output from the r-f amplifier plate cavity which flows thru RF MONITOR 1M2. It is set so that the indicator of 1M2 remains on scale. This control is adjusted in conjunction with the setting of the red pointer on RF MONITOR 1M2.

h. The METER SW (1S1) allows various current and voltage readings of the transmitter and associated units to be observed on test meter 1M1.

Position 250 measures 250 v dc B+ from the power supply. (1000 volts full scale)

Position 500 measures 500 v dc B+ from the power supply. (1000 volts full scale)

Position OSC measures the cathode current of r-f oscillator 1V2. (200 milliamps full scale)

Position MIX measures the cathode current of mixer 1V3. (200 milliamps full scale)

Position AMPL measures the cathode current of r-f amplifier 1V4. (200 milliamps full scale)

*Position + measures positive voltages. (200 microamps full scale)

*Position – measures negative voltages. (200 microamps full scale)

* From test points in this and other units by means of a test lead connected to the METER jack.

i. The DC AMPL BIAS control (1R5) varies the cathode bias of the 6-7-8 section of dc amplifier 1V1, the AFC relay control tube.

j. The Test Meter (1M1) (to the right of the meter switch) is used in conjunction with meter switch 1S1 to measure various circuit values in the transmitter unit and, by means of a plug-in test lead, to make current measurements in the other units.

k. METER pinjack (1J7) is the test lead connection when test meter 1M1 is used to measure voltage and current values in associated units.

l. The RF MONITOR r-f meter and relay (1M2), a combination r-f output meter and fault relay, gives a relative indication of r-f carrier output and functions as a fault reporting relay when the r-f output reaches a predetermined low value.

m. The L.O. (local oscillator) coaxial cable terminal (1J1) is used for supplying a portion of the local oscillator energy to the receiver r-f mixer stage.

n. The A.F.C. coaxial cable terminal (1J2) is used for transferring a portion of the transmitter output signal to the AFC mixer in the terminal AFC unit. Only used for terminal stations.

o. The 70 MC INPUT coaxial cable terminal (1J5) is the input connection for the coaxial cable carrying the 70 mc i-f signal from the receiver/-modulator.

p. The A.F.C. MOTOR INDICATOR (lamps 1I1 and 1I2) show when the AFC motor is running and in which direction. When the motor is correcting the local oscillator frequency, one of the lamps is lit and when the frequency correction is complete the lamp is extinguished.

q. The A.F.C. MOTOR SWITCH 1S3 is used for opening the 115 v ac line to AFC motor 1B1 to disable it during installation or servicing.

r. The 70 MC INPUT signal jack 1J9 is used for checking the 70 mc signal input level from the receiver/modulator.

s. The AFC LOOP INDICATOR shows the position of the AFC tuning loop in the local oscillator cavity. The pointer, when moved, changes the angle of the loop in the cavity. When the pointer is at the 0 position, the loop is at approximately 45° from the vertical, the correct position of the loop in the cavity.

MAINTENANCE

General Notes

If the transmitter power output is decreasing the following notes may facilitate isolating the difficulty:

a. First, check the 70 mc drive to the transmitter mixer by turning off the 500 volts supply. The "MIX" reading should be greater than 35 ma. (The 40 ma figure listed in the INITIAL ADJUSTMENT section of the system instructions is the expected minimum for new tubes.) The reading obtained on 1M1 when 1J9 is connected to 1J7 should be at least 30 ma.

If the "MIX" reading is below 35 ma check the 70 mc signal voltage input from the receiver/modulator. The 30 μa reading at 1J9 is equivalent to 1 volt at 1V5-3. If this value is less than 1 volt the receiver/modulator is not delivering enough drive to the transmitter and the correction will have to be made in the receiver/modulator unit. If the input to 1V5 is sufficient, check both 1V5 and 1V6 tubes and replace if necessary.

b. Second, check the quality of the oscillator tube by noting how much its cathode current increases as the tube changes from a non-oscillating to an oscillating condition. (The bottom oscillator slug can be detuned to stop oscillation.) The current should increase by approximately 3:1 for a good tube. If the increase is less than 1.5:1 the tube should be replaced.

c. If the oscillator is supplying adequate drive to the mixer the mixer tube cathode current (meter

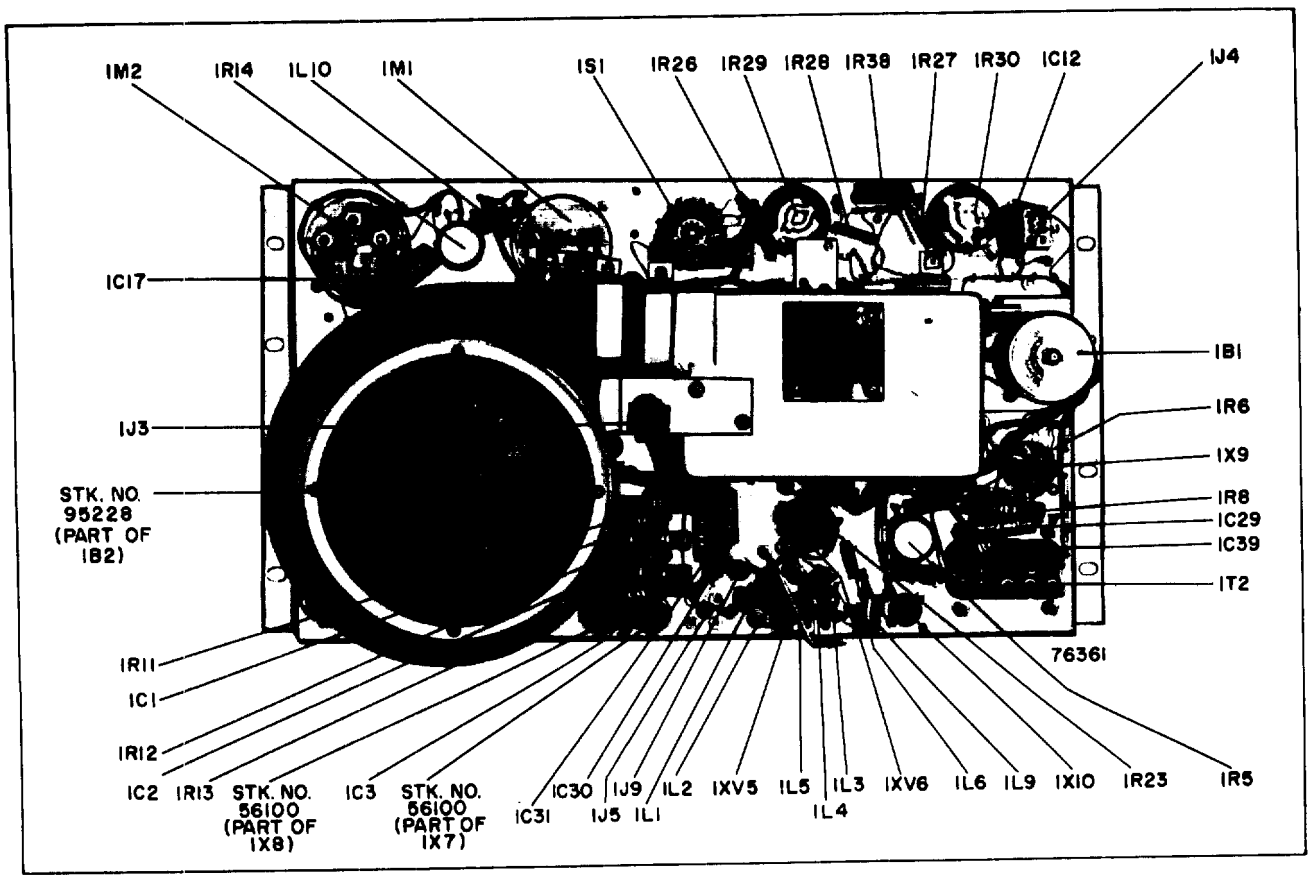


Figure T-2—Transmitter—Rear View

switch at MIX) should drop to roughly 50% of the normal value when the 70 mc cable is removed. If this decrease is of the order of only 10%, a point of marginal operation has been reached. The mixer cathode current is determined in part by the oscillator drive. If the mixer cathode current exceeds 125 ma, the oscillator cathode current should be reduced.

d. A poor 2C39A amplifier is frequently revealed by an inability to get adequate cathode current, with sufficient drive from the mixer, as the cathode variable resistor (1R29) is decreased. When less than 75 ma of "AMPL" cathode current is obtained with 1R29 set at minimum the amplifier tube should probably be replaced.

e. If the transmitter fails completely it may be caused by a defective 2C39A electron tube or the breakdown of capacitors 1C19, 1C23 or 1C26. If one of these capacitors is shorted due to dust and moisture or if certain elements of tubes 1V2, 1V3 or 1V4 become shorted, then the 500 v B+ power is short circuited and fuse 5F16 in the power supply will be blown. The tube circuit at fault can readily be found by noting which of the arc indicating fuses 1F1, 1F2 or 1F3 is blown.

f. Variable resistor 1R14 "MONITOR ADJUST" is used to adjust the operating point of meter relay 1M2. A suggested setting of 1R14 is that which will give a 1M2 reading of 150 μa. Set the red hand of 1M2 at the meter reading below which the transmitter output should not fall. Meter/Relay 1M2 will report a transmitter fault to the service unit when the transmitter output falls to this value.

g. Both the transmitter AFC motor and the blower motor have lifetime lubricated bearings. The grease sealed bearings of the blower section of the blower-motor should be inspected periodically and replaced with new bearings when necessary. The normal life of the bearings is between three and four years.

h. If the blower motor runs but the tube filaments do not burn, check the operation of the air operated switch 1S2.

Transmitter AFC Circuit

As d-c amplifier tube 1V1 ages, D.C. AMPL. BIAS potentiometer 1R5 must be readjusted to keep the i-f frequency of the receiver/modulator centered at 30 mc. When the range of adjustment provided by 1R5 is no longer adequate to center the i-f, 1V1 must be replaced.

Transmitter AFC Circuit Test

If the transmitter AFC circuit fails to respond to the dc correction signals from the discriminator of the receiver/modulator, the d-c amplifier may be the cause.

Check the sensitivity of the d-c amplifier 1V1 as follows (with the AFC motor 1B1 connected for upper side band operation as shown in Figure T-3):

1. Apply + .15 volts to pin 1 of jack 1J4 and ground. This voltage should cause the AFC motor indicator light, marked +, to light.

2. Apply – .15 volts to pin 1 of jack 1J4 and ground. This voltage should cause the AFC motor indicator light, marked –, to light.

3. Check the action of the clutch by moving the loop indicator by hand.

70 MC Circuit Alignment

NOTE: The test items specified in this alignment procedure refer to the test equipment items listed in the test equipment tables of the system instructions.

a. Apply the output of the 70 mc sweep generator (test item 18), with markers, to 1V6-5. (Tube shields of 2E26 and 6CL6 and the shields of transformer 1T1 must be in place.)

b. Connect the CRO (test item 4) to the cathode of 1V3 (2C39A mixer tube).

c. Turn on the 115 volt a-c and 250 volt d-c supplies.

d. Adjust 1T1 and 1C33 for correct alignment. The response is that of an over-coupled double-tuned circuit with peaks approximately 12 megacycles apart.

NOTE: Should it be impossible to align this stage the reason is, most likely, that either of the two circuits is not tuned to 70 mc ±1 mc. The resonant frequencies of the two circuits are easily checked with test item 12.

TYPICAL TRANSMITTER VOLTAGES AND METER READINGS

The following are approximate voltages existing between the indicated tube pins and ground as measured with a voltohmyst with 100,000 ohms in series with the measuring probe. All voltages are dc unless otherwise noted.

Tube	*Type*	*Function*	*Pin 1*	*Pin 2*	*Pin 3*	*Pin 4*	*Pin 5*	*Pin 6*	*Pin 7*	*Pin 8*	*Pin 9*
1V1	12AT7	DC ampl.	90	0	1.8	0	0	250	90	92	6.3 ac
1V5	6CL6	70 mc. ampl.	2.3	0	117	0	6.3 ac	228	2.3	117	—
1V6	2E26	70 mc. ampl.	15	0	185	15	0	15	6.3 ac	—	Plate cap 250

The following are typical readings of test meter 1M1 for the various positions of "METER SW" 1S1:

250v— 50 μa
500v—100 μa } Meter connected as a voltmeter of roughly 1000 volt full scale reading

OSC—70 ma

MIX.—100 ma max., 60 ma min.

AMPL.—100 ma max.

\+ } In these positions the meter is connected to an external probe for use in testing other
— } unit quantities

e. Connect the CRO to 1V6-3, connect the sweep generator to 1V5-2, and adjust 1L3, 1L4, and 1L5 for the correct response. The response curve is nearly flat with 3 db points 10 mc apart.

f. Connect the CRO to 1V5-8, connect the sweep generator to Pin No. 1 of the 70 mc amplifier 2V11 and connect the 70 MC OUTPUT jack 2J9 to the 70 MC INPUT jack 1J5 of the transmitter and adjust 1L1 and 1L2 for the correct response.

g. Connect the CRO to the cathode of 1V3 to check the overall response.

IMPORTANT

If the repair of cavity 1Z1 is required and if the removal of the mounting assemblies of electron tubes 1V2, 1V3 and 1V4 is necessary it is important that these parts be very carefully positioned upon reassembly. If the opening in the plates of these assemblies are not in line the tubes are likely to be broken when inserted. For proper installation of these tube mounting assemblies use the following instructions:

1. Install the ring assembly in the holes of the partition between the two cavity sections and tighten the screws.

2. Install the assembly that holds the cathode and filament terminals (small end) of the tubes but leave the mounting screws very loose.

3. Install the assembly that holds the plate (large end) terminal of the tubes but leave the mounting screws loose.

4. Insert a 2C39A tube allowing all parts to center about the tube. Tighten all screws with the tube in place. Remove the tube.

The installation of tubes 1V2, 1V3 and 1V4 may now be done without danger of damage to the tubes.

REPLACEMENT PARTS LIST

Symbol No.	*Description*	*Drawing No.*	*Stock No.*
1B1	Motor, timing motor and gear unit, 110 v., 60 cycle (afc drive)	8832092-1	94203
1B2	Blower, 115/230 v., 50/60 cycle, 3300 r.p.m (not stocked complete, see parts below)	741276-4	
	See 1C16 for motor capacitor.		
	Motor, for blower 1B2, 115/230 v., 50/60 cycle, 3300 r.p.m. (pt. of 1B2)	741276-2	94204
	Bearing, ball, for blower motor (pt. of 1B2)	8830675-2	95228
1C1 to 1C3	Capacitor, fixed, paper, 0.01 mf ±10%, 1000 v	735715-363	73565
1C4	Capacitor, fixed, silver mica, button type, 1000 mmf ±10%, 500 v	984002-121	94189
1C5 to 1C8	Capacitor, fixed, ceramic, 820 mmf –0% +100%, 500 v	449696-1	94190
1C9	Capacitor, fixed, ceramic, 220 mmf ±20%, 500 v	735717-633	95319
1C10, 1C11	Capacitor, fixed, ceramic, 820 mmf –0% +100%, 500 v. Same as 1C5	449696-1	94190
1C12	Capacitor, fixed, paper, 0.1 mf ±20%, 200 v	735715-25	73784
1C13 to 1C15	Capacitor, fixed, ceramic, feed through, 1000 mmf +80% –20%, 500 v	8828585-3	203760
1C16	Capacitor, fixed, paper, 4 mf, 330 v.ac, for blower motor	8832059-1	19464
1C17	Capacitor, fixed, paper, 0.47 mf ±20%, 200 v	735715-33	73787
1C18 to 1C27, incl.	Capacitor, part of 1Z1.		
1C28	Capacitor, fixed, ceramic, 820 mmf –0% +100%, 500 v. Same as 1C5	449696-1	94190
1C29	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v	735715-175	73551
1C30, 1C31	Capacitor, fixed, paper, 0.033 mf ±20%, 400 v	735715-119	73552
1C32	Capacitor, fixed, ceramic, 22 mmf ±5%, 500 v	984015-218	93716
1C33	Capacitor, variable, ceramic trimmer, 4.5 to 28 mmf	8819214-1	203761
1C34	Capacitor, fixed, ceramic, 220 mmf ±20%, 500 v. Same as 1C9	735717-633	95319
1CR1	Rectifier, germanium diode, 1N21B	Type 1N21B	67876
1CR2	Rectifier, germanium diode, 1N48	Type 1N48	203954
1F1 to 1F3	Fuse, cartridge, 1/32 amp., 250 v., 1" lg. x ¼" dia.	8851771-17	69417
1I1, 1I2	Lamp, neon, starting volts, 65 v.ac, 90 v.dc, min. bay base	872291-9	91749
1J1, 1J2	Connector, female, coaxial, chassis mounted with ¼" long cavity loop (part of 1Z1)	456989-501	94248
1J3	Connector, female, coaxial, chassis mtg., with loop and teflon beads (r-f output)	460231-503	203972
1J4	Connector, male, 6 contact, chassis mtg.	181494-3	28507

Symbol No.	Description	Drawing No.	Stock No.
1J5	Connector, female, co-axial, chassis mtg.	8845666-1	94205
1J6	Connector, male, 6 contact, chassis mtg. Same as 1J4	181494-3	28507
1J7	Connector, pin jack for 0.080 dia. pin	742565-1	93678
1J8	Connector, female, 6 contact, chassis mtg.	181494-4	18534
1J9	Connector, pin jack for 0.080 dia. pin. Same as 1J7	742565-1	93678
1K1	Relay, differential polarized, s.p., 3 pos. null seeking, coils each 3500 ohms, octal plug-in type	8834407-1	94206
1L1	Coil, iron core, adj. 3 turns of 0.0126 dia. wire on form 0.920 lg.	629132-522	94207
1L2	Coil, iron core, adj. 5 turns of 0.0126 dia. wire on form 0.920 lg.	629132-524	94208
1L3	Coil, iron core, adj. 11 turns of 0.0126 dia. wire on form 0.920 lg.	629132-517	94245
1L4	Coil, iron core, adj. 15 turns of 0.0126 dia. wire on form 0.920 lg.	629132-527	94239
1L5	Coil, iron core, adj. 6 turns of 0.0126 dia. wire on form 0.920 lg.	629132-520	94211
1L6	Reactor, iron core, 2.5 microhenry	8834424-501	94040
1L7	Reactor, r-f choke, 7.5 microhenry, 275 ma	459688-76	205050
1L8	Part of 1Z1.		
1L9	Reactor, r-f choke, 7.5 microhenry. 275 ma. Same as 1L7	459688-76	205050
1L10	Reactor, r-f choke, 2.5 mh, 50 ma	8886161-6	98426
1L11	Reactor, r-f choke, 0.84 microhenry, 1000 ma	8898641-2	57239
1M1	Meter, d-c, 0-200 microampere	456986-1	94213
1M2	Meter, d-c, special, 0-200 microampere with switch and contact locking winding, single contact, low limit adjustable	8834409-1	94214
1P1	Connector, male, 6 contact, cable mtg. type	181494-2	28454
1R1	Resistor, fixed, composition, 4.7 meg ±20%, ½ w	82283-35	30931
1R2	Not used.		
1R3	Resistor, fixed, composition, 150 ohm ±5%, ½ w	82283-139	502115
1R4	Resistor, fixed, composition, 180,000 ohm ±10%, ½ w	82283-89	502418
1R5	Resistor, variable, composition, 5000 ohm ±10%, 2 watts, screw driver slotted shaft	737829-30	94039
1R6	Resistor, fixed, composition, 6800 ohm ±10%, 2 w	99126-72	522268
1R7, 1R8	Resistor, fixed, composition, 30,000 ohm ±5%, 2 w	99126-194	522330
1R9	Resistor, fixed, composition, 120,000 ohm ±5%, 2 w	99126-209	522412
1R10	Not used.		
1R11 to 1R13	Resistor, fixed, wire wound, 50 ohm ±10%, 10 w	8825410-54	59282
1R14	Resistor, variable, composition, 50,000 ohm ±10%, 2 w., screw driver slotted shaft	737829-32	203068
1R15	Resistor, fixed, composition, 27,000 ohm ±5%, ½ w	82283-193	502327
1R16	Resistor, fixed, composition, 1500 ohm ±10%, ½ w	82283-64	502215
1R17	Resistor, fixed, composition, 100 ohm ±10%, ½ w	82283-50	502110
1R18	Resistor, fixed, composition, 3300 ohm ±10%, ½ w	82283-68	502233
1R19	Resistor, fixed, composition, 27,000 ohm ±10%, 1 w	90496-79	512327
1R20	Resistor, fixed, composition, 1000 ohm ±20%, ½ w	82283-13	502210
1R21	Resistor, fixed, composition, 1500 ohm ±10%, ½ w. Same as 1R16	82283-64	502215
1R22	Resistor, fixed, composition, 470 ohm ±10%, ½ w	82283-58	502147
1R23	Resistor, fixed, composition, 47,000 ohm ±10%, 1 w	90496-82	512347
1R24	Resistor, fixed, composition, 100 ohm ±10%, ½ w. Same as 1R17	82283-50	502110
1R25	Resistor, fixed, composition, 10,000 ohm ±10%, ½ w	82283-74	502310
1R26 to 1R28	Resistor, fixed, wire wound, 0.66 ohm ±1%, 1 w., meter shunt	8871557-11	56327
1R29, 1R30	Resistor, variable, wire wound, 500 ohm ±10%, 25 w., screw driver slotted shaft	180639-8	95312
1R31	Not used.		
1R32	Resistor, fixed, composition, 4.7 meg ±5%, ½ w	82283-247	30931
1R33	Resistor, fixed, composition, 100 ohm ±10%, ½ w. Same as 1R17	82283-50	502110
1R34	Resistor, fixed, composition, 4.7 meg ±5%, ½ w. Same as 1R32	82283-247	30931
1R35, 1R36	Resistor, fixed, composition, 270,000 ohm ±10%, ½ w	82283-91	502427
1R37	Resistor, fixed, composition, 10,000 ohm ±10%, ½ w. Same as IR25	82283-74	502310
1R38	Resistor, fixed, wire wound, 100 ohm ±5%, 5 w	458572-26	94377

Symbol No.	Description	Drawing No.	Stock No.
1R39	Resistor, fixed, wire wound, 0.38 ohm ±10%, 5 w	458592-1	97911
1R40 to 1R42	Resistor, fixed, composition, 150 ohm ±10%, 1 w	90496-52	512115
1S1	Switch, rotary, wafer, single section, 1 circuit, 7 pos., non-shorting	458908-1	94193
1S2	Switch, rotary, snap action, s.p.s.t., normally open contacts	449277-1	59479
1S3	Switch, toggle, s.p.s.t.	187454-2	48791
1T1	Transformer, r-f adj. iron core, 70 mc	8819222-501	203762
1T2	Transformer, filament	469743-1	207287
1V2, 1V3, 1V4	Tube, u.h.f., triode (MI-31132-2 only)	Type 2C39-A	207832
1X1	Socket, 9 pin, tube	984055-2	56333
1X2 to 1X4	Part of 1Z1.		
1X5	Socket, tube, 9 pin. Same as 1X1	984055-2	56333
1X6	Socket, tube std, octal, natural phenolic	99391-1	68590
1X7, 1X8	Pilot light assembly	8834425-1	
	Socket, pilot light socket only less jewel and lamp (part of 1X7 and 1X8)	Pt. of 8834425-1	56100
	Jewel, pilot light clear jewel only less socket and lamp (part of 1X7 and 1X8)	Pt. of 8834425-1	94121
1X9	Socket, tube, std, octal, black phenolic compound	99100-3	68590
1X10	Socket, tube, 7 pin min.	737867-18	94879
1Z1	Cavity Assembly (MI-31132-1) not stocked complete	636644-501	
	Cavity Assembly (MI-31132-2) not stocked complete	636644-502	
	The following parts only available:		
	Bushing, textolite, 0.499 O.D. x 0.470 I.D. x 0.160 lg. (mixer capacitor insulating)	8831010-1	94270
	Contact, beryllium copper, grid contact ring, including osc. loop, for 2C39-A tubes	8903740-502	207375
	Contact, beryllium copper, grid contact ring, less osc. loop, for 2C39-A tubes	8903740-501	207374
	Contact, beryllium copper, plate contact ring, for 2C39-A tubes	750302-501	203765
	Contact, flared beryllium copper, filament contact stud, for 2C39-A tubes	8832042-2	207378
	Contact, flared beryllium copper, cathode contact ring, for 2C39-A tubes	8903749-501	207376
	Core, brass, #5/8"-24 threaded type, 1 7/8" lg. overall, cavity tuning	8903730-1	207377
	For coaxial connectors—see 1J1 and 1J2		
	Insulator, laminated phenolic, 7/8" O.D. x 0.116" I.D. x 1/16" thick, with 3/16" dia. off-set hole, filament contact insulating, for 2C39-A tubes	8831012-2	207379
	Nut, brass, #5/8"-24 hex, tuning core locking	874927-6	95395
	Washer, spring, beryllium copper, 21/32" I.D. x 25/32" O.D. x 0.015" thick, tuning core locking	8903734-1	207380
	Nut, mixer capacitor, brass, knurled, 1"-32 inside thread 3/4" I.D., opposite side, 1 1/16" O.D. x 3/32	8831011-1	94269
	Washer, mica, 1/2" O.D. x 0.484 I.D. x 0.006 thick (filament contact insulating for 1V/X2, 1V/X3, 1V/X4)	892950-3	203766
	Miscelianeous		
	Boot, blower, wool gabardine, 2 31/32" dia. x 2" lg.	8832079-1	94385
	Connector, male, pin jack, cable mtg.	185290-1	93856
	Connector, tube cap, for 1V6	888550-1	207701
	Cushion, afc drive assembly mounting rubber 7/8" lg. x 1/4" x 3/16" with 1/16" wide x 1/8" deep channel (piece supplied 19" lg.)	8833025-4	94784
	Insulator, textolite, 9/32" lg. x 0.447 O.D. x 0.254 I.D. (1CR1 and 1C4 mtg.)	8834421-1	94382
	Knob, round black bakelite pointer type (for 1S1)	712336-507	30075
	Lever, 1S2 switch activating lever and plate assembly	8832071-501	94383
	Screw, thumb, #6-32 x 5/16" lg. overall, with 13/32" dia. x 3/8" lg. knurled hd., cover plate retaining	8831054-1	94381
	Shield, tube, 7 pin min., 2 1/4" lg.	99369-3	57540
	Shield, tube, 9 pin min. 1 15/16" lg.	8858642-3	56359
	Spring, helical mounted on plate, 1 5/16" sq. (blower shock mtg., 3 req'd)	8834442-501	94387
	Strap, steel, 0.0179 thick x 11 1/8" lg. x 1/2" wide (blower boot clamping) (2 req'd)	8832080-1	94386

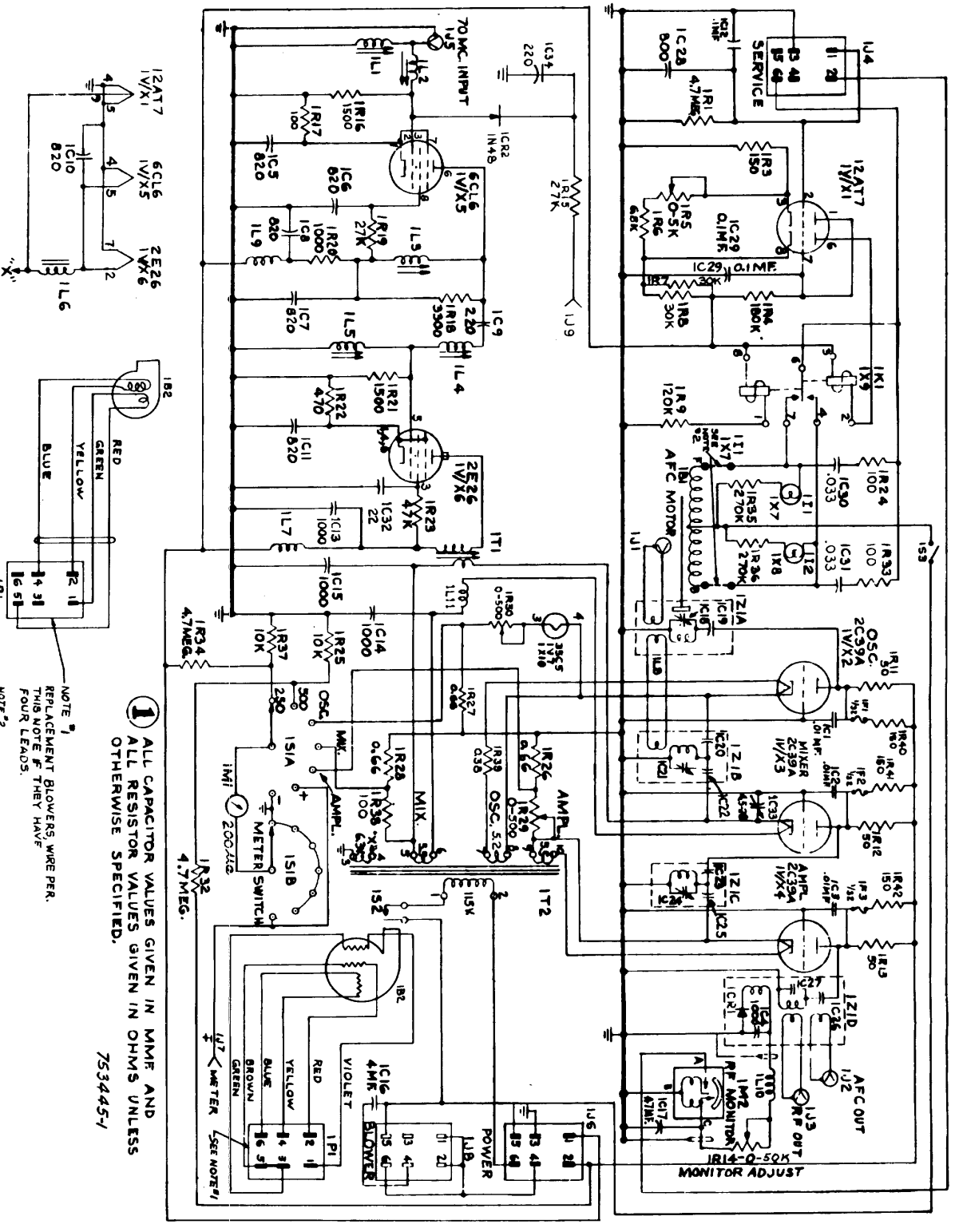


Figure T-3—Transmitter—Schematic Diagram

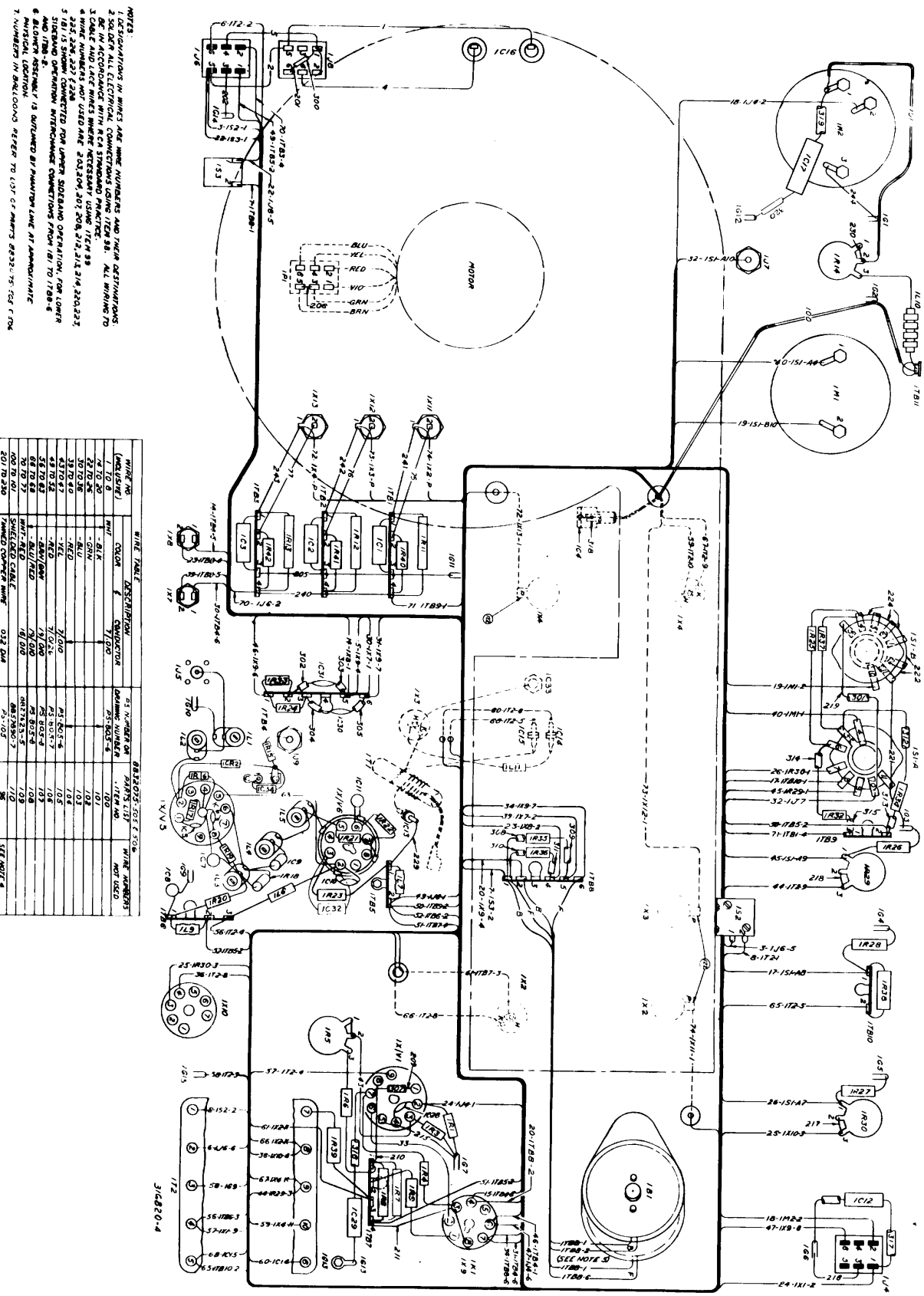


Figure T-4—Transmitter—Wiring Diagram

I

MICROWAVE COMMUNICATION EQUIPMENT

Receiver / Modulator MI-31491-E

- TECHNICAL DATA
- DESCRIPTION
- MAINTENANCE
- REPLACEMENT PARTS

RADIO CORPORATION OF AMERICA
COMMERCIAL ELECTRONIC PRODUCTS, CAMDEN, N. J.

PRINTED IN U. S. A.
517

TECHNICAL DATA

Power Input:
a. Filament Heaters: 35 watts at 115 v, 50/60 cycle ac
b. Plate Supply: 130 milliamps at 250 v dc

Frequency Range
1700-1990 megacycles

Receiver Band Width
6 megacycles

Receiver Noise Figure
12 db

I.F. Frequency
30 mc

R.F. Input Impedance
50 ohms

Carrier Operated Relay Sensitivity
C/N = 12 db max.

Baseband Output for ±1.5 mc Peak Deviation
1.2 v rms

Baseband Output Frequency Range
3 kc to 160 kc

Service Channel Output for ±75 kc Peak Deviation
7 v rms

Service Channel Frequency Response
300 cps to 3 kc ±2 db

Service Channel Signal-to-Noise Ratio
(below ±75 kc peak deviation)
35 db

Modulator Input for ±1.5 mc Peak Deviation
0.85 v

Relays

Symbol	*Function*
2K1	Receiver Fault
2K2	Noise Suppression
2K3	Standby Lockout/Loss-of-Signal Remote-Indication

Crystals

Symbol	*Type*	*Function*
2CR1	1N21B	RF Mixer
2CR2	CK705	RF Rectifier
2CR3	CK705	First Limiter
2CR4	CK705	First Limiter
2CR5	CK705	Second Limiter
2CR6	CK705	Second Limiter
2CR7	CK705	RF Rectifier

Tube Complement

Symbol	*Type*	*Function*
2V1	6CB6	First i-f Amplifier
2V2	6CB6	Second i-f Amplifier
2V3	6CB6	Third i-f Amplifier
2V4	6CB6	Fourth i-f Amplifier
2V5	6CB6	Fifth i-f Amplifier
2V6	6CB6	Sixth i-f Amplifier
2V7	6CB6	First Limiter
2V8	6CB6	Second Limiter
2V9	6AL5	Discriminator
2V10	6AS6	Modulator Mixer
2V11	6CB6	70 MC Amplifier
2V12	6AH6	FM Modulator
2V13	12AT7	40 MC Oscillator
2V14	12AT7	Fault Oscillator
2V15	6CB6	Baseband Amplifier
2V16	12AT7	Service Channel Amplifier
2V17	12AX7	Lockout Amplifier
2V18	12AT7	Lockout Amplifier

Weight and Dimensions
Weight—15 lbs.
Height—8¾"
Depth back of panel: 2⅞"
Depth front of panel: 4"
Width: 19" Rack Mounting

DESCRIPTION

The Receiver/Modulator is designed for mounting in either a standard 19" open rack or cabinet and is used in both terminal and repeater stations. The unit has two main functions. The receiver section amplifies and demodulates the incoming f-m signal from a terminal or repeater station and delivers the .3 to 160 kc information to the baseband and/or service units. The modulator section provides the transmitter with a 70 mc f-m carrier, modulated with the .3 to 160 kc multiplex and service channel signals. In a receiver at a repeater station the modulation on this 70 mc carrier also includes the incoming modulation on the 30 mc i-f signal.

Receiver

In the receiving section the incoming microwave signal is first converted to a 30 mc i-f. This is accomplished by mixing the microwave signal with a sample of the transmitter local oscillator frequency. These two frequencies are always 30 mc apart in accordance with the system plan. Refer to the system instructions for Typical Systems Frequencies. This mixing is done in mixer cavity 2Z1 which receives the microwave signal through a coaxial cable from the receiving filter unit. This cable is connected to cavity terminal 2J1 on the back of the chassis. A sample of the transmitter local oscillator frequency is fed by means of a

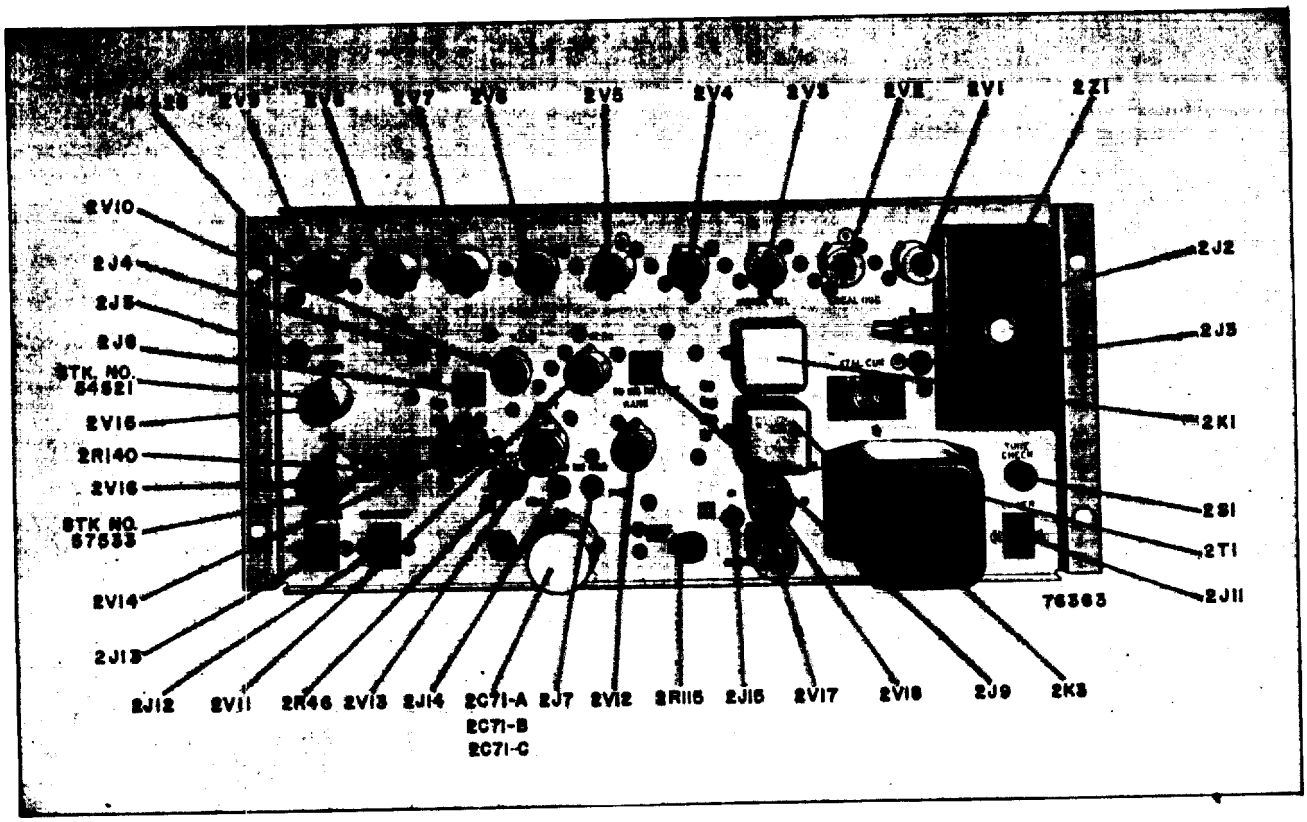


Figure RM-1—Receiver/Modulator—Front View

coaxial cable from terminal 1J1 of the transmitter to terminal 2J2, labeled LOCAL OSC., of the mixer cavity 2Z1. The difference frequency is generated by the mixer cavity crystal 1N21B and delivered to the grid of the first 30 mc i-f stage. The screwdriver adjusting control on the front of 2Z1 resonates the cavity to the correct frequency. Coupling loop 2J2 couples the local oscillator energy into the mixer cavity. The 30 mc output of cavity 2Z1 is amplified by 6 stages (2V1 thru 2V6) of i-f amplifiers to a sufficiently high level so that proper limiting action can take place in the two limiting stages 2V7 and 2V8. Each of the two limiting stages contain dual limiting circuits. Besides the limiting that occurs in the electron tubes, additional limiting action is performed in the circuits containing crystals 2CR3 and 2CR4 of the 1st limiter stage and crystals 2CR5 and 2CR6 of the 2nd limiter stage. The 30 mc output of the 2nd limiter stage is fed to discriminator 2V9 where the f-m signal is demodulated and the 300 cycle to 160 kc component delivered to baseband amplifier 2V15. The output of 2V15 is delivered to the baseband unit through 2J12-5 at all terminal and drop repeater stations. A portion of the output of 2V15 is applied to service channel amplifier 2V16. At stations using a Repeater Service Unit MI-31495 or Terminal Service Unit MI-31496 the output of 2V16 is supplied directly to the service unit through 2J13-2. At terminal and drop repeater stations using the indicon service channel system, signals to Service Channel Unit MI-31140 are supplied by the baseband unit through 4J3-5. At thru repeater stations using the indicon service channel system the output of 2V16 is supplied to Service Channel Unit MI-31140 through 2J12-5. A connection to terminal 1 of jack 2J13 from the discriminator output provides the dc amplifier of the transmitter AFC circuit with the dc correction voltage when the transmitter local oscillator drifts off frequency.

Modulator

In the modulator section, mixer 2V10 produces the 70 mc i-f signal which modulates the transmitter microwave carrier. Amplifier 2V11 amplifies the 70 mc i-f output of the modulator i-f mixer which is then coupled by coaxial cable to the transmitter by means of 70 MC OUTPUT jack 2J9. The source of the two signals that supply modulator i-f mixer 2V10 with its heterodyning frequencies differ for each type of station as follows:

a. At a terminal station the 70 mc subcarrier output of the modulator i-f mixer 2V10 is the difference frequency of a 110 mc and a 40 mc signal. The 40 mc signal is the output of oscillator 2V13 and contains the multiplex and service channel signals from the baseband unit. The 110 mc frequency is received from the terminal AFC and is coupled through a coaxial cable to the 110 MC INPUT jack 2J8 of the receiver/modulator. At terminal stations only, internal bus connection "P" must be made to jack 2J8, connection "O" made at jack 2J12, coil 2L47 shorted, and connection "L" omitted. (The letters "P", "O" and "L" refer to connections found on the receiver/modulator schematic of figure RM-11.) Adding connection "P" feeds the 110 mc frequency from the terminal AFC unit to the modulator i-f mixer 2V10. Removing connection "L" disconnects the receiver 30 mc signal from 2V10. Shorting 2L47 prevents 2V14 from operating as a 110 mc oscillator. Adding connection "O" maintains the proper baseband output load impedance when only one receiver/modulator unit is used as at a terminal station. The amount of baseband signal applied to 2V12 is determined by the setting of Modulator Gain control 2R109 which is adjusted at the factory so that the modulation sensitivity of all receiver/modulator units will be the same.

b. At drop repeater stations the 70 mc subcarrier output of the modulator i-f mixer 2V10 is the sum frequency of a 30 mc and a 40 mc signal. The signal from the 40 mc oscillator 2V13 and frequency modulator 2V12 contains the 300 cycle to 160 kc multiplex and service channel frequencies added at this station. The 30 mc signal comes from the receiver 1st limiter stage output and contains the intelligence modulated on the received microwave signal.

c. The modulator section of a thru repeater station is the same as that of a drop repeater station except the 40 mc oscillator signal to the modulator-mixer stage 2V10 contain only 300 cycles to 3 kc service channel information (voice communication and fault tone pulses) from the service unit.

In repeater stations the 30 mc frequency to the modulator mixer stage 2V10 comes from the 1st

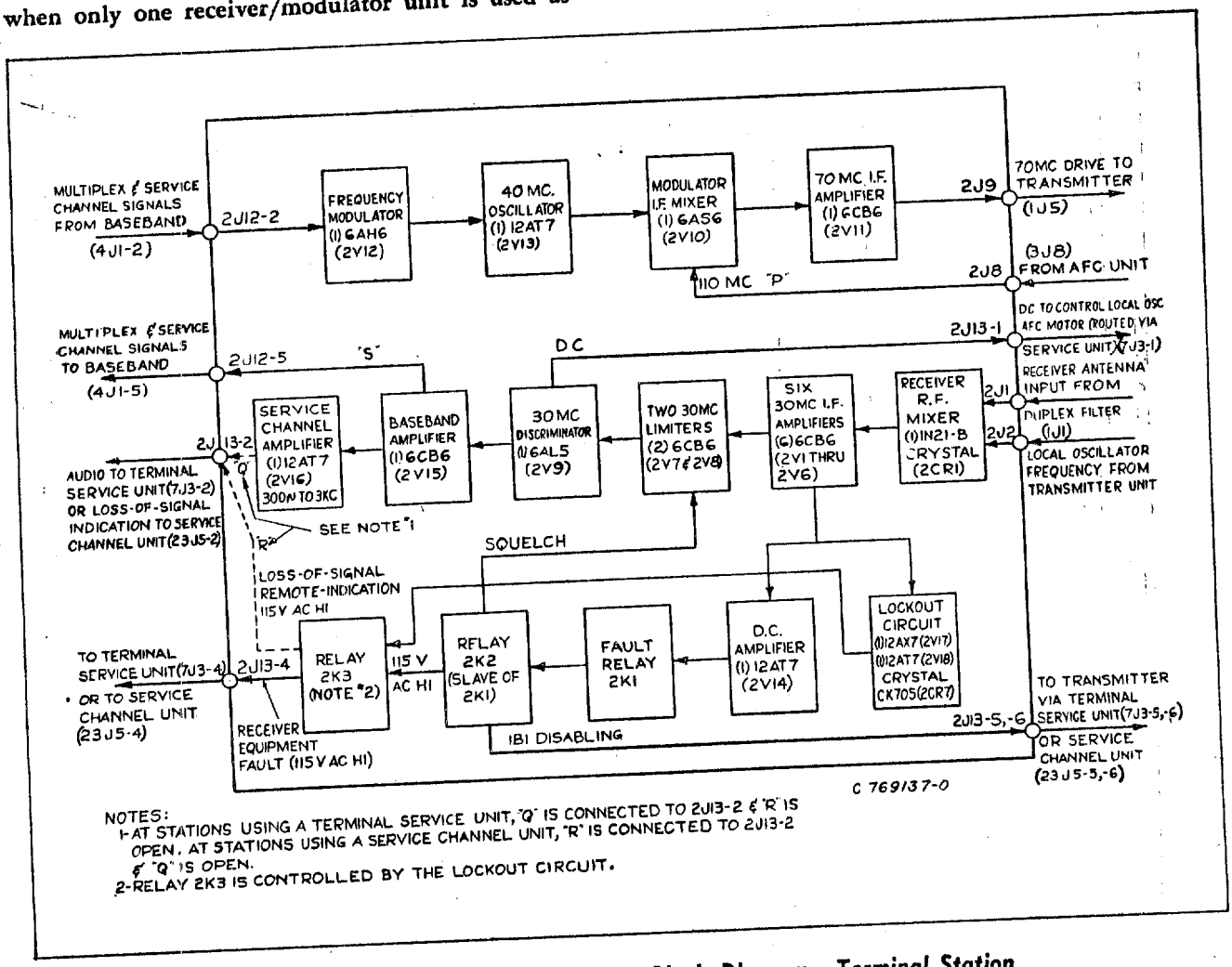


Figure RM-2—Receiver/Modulator—Block Diagram—Terminal Station

limiter (2V7) output circuit. Be certain that internal connection "L" is made when the receiver/-modulator is used in either a drop repeater or a thru repeater station and removed when used at a terminal station.

Operation of Relays 2K1, 2K2 and 2K3

If the i-f amplifier strip fails to function or the incoming signal fades below threshold or is lost completely, the positive d-c voltage (from crystal 2CR2 of the 6th receiver i-f stage) normally present at pin 2 of 2V14 is greatly reduced, causing the 6-7-8 section to 2V14 to conduct.

At a drop or thru repeater station the 6-7-8 section of 2V14 is a 110 mc oscillator which supplies one of the two heterodyning frequencies to 2V10. The 110 mc frequency is heterodyned with the 40 mc oscillator output providing a 70 mc frequency (110 mc – 40 mc) to keep the transmitter radiating a quieted carrier. Relay 2K1 in the plate circuit of the 6-7-8 section of 2V14 is energized when 2V14 starts oscillating.

At a terminal station the 110 mc output of 2V14 is not required. Tube 2V14 is changed to a d-c amplifier by shorting out plate coil 2L47. When 2V14 is operated by an i-f failure or loss-of-signal, relay 2K1 is energized.

Relay 2K1 Operation

Contact 3-4 closes, energizing relay 2K2.

Relay 2K2 Operation

1. Contact 2-4 opens, breaking the B+ circuit to limiters 2V7 and 2V8.

2. Contact 2-3 closes, grounding the plate and screen circuits of limiters 2V7 and 2V8. This, in conjunction with the action of contact 2-4, disables limiters 2V7 and 2V8. With no input to discriminator 2V9 and mixer 2V10, any noise voltage

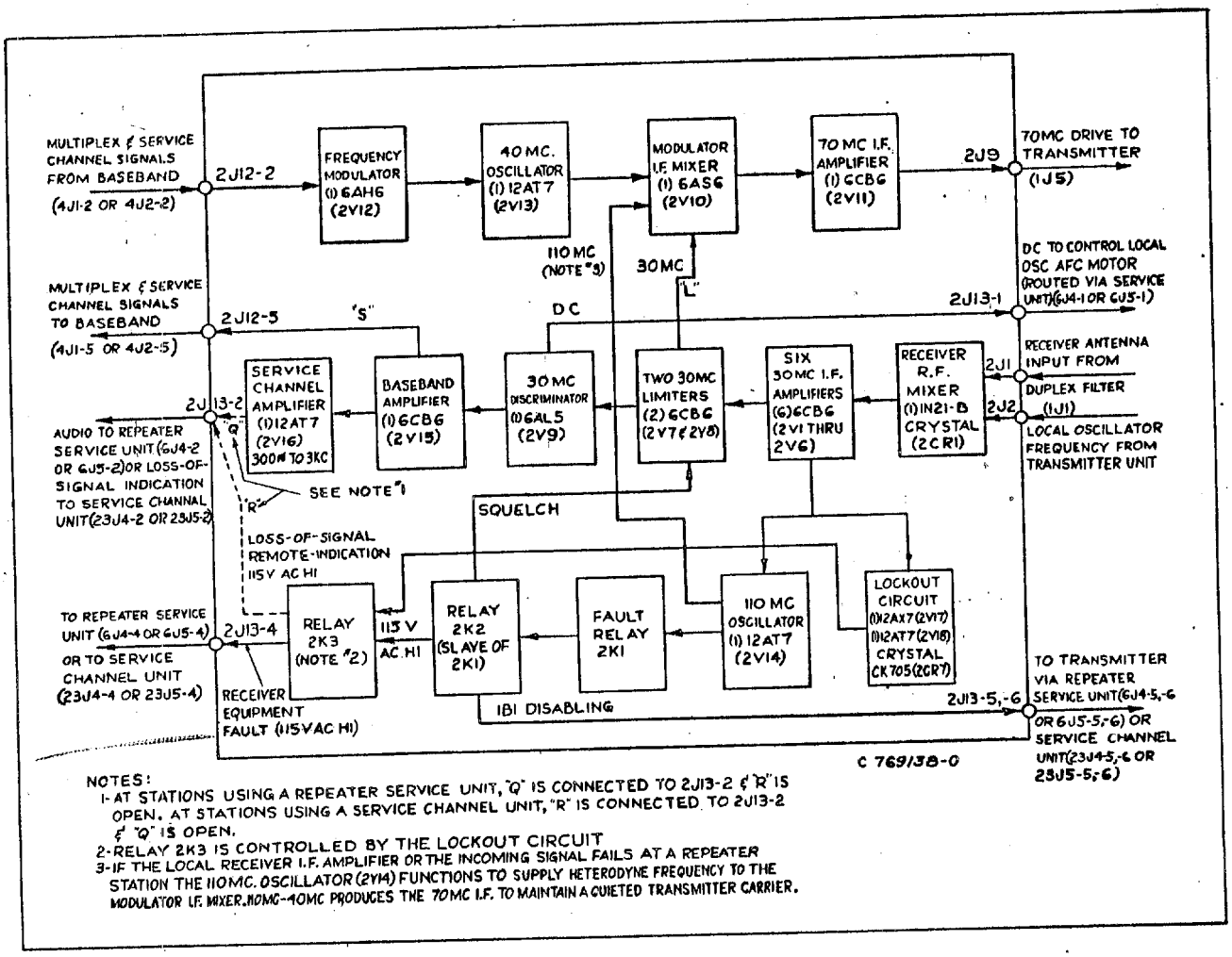
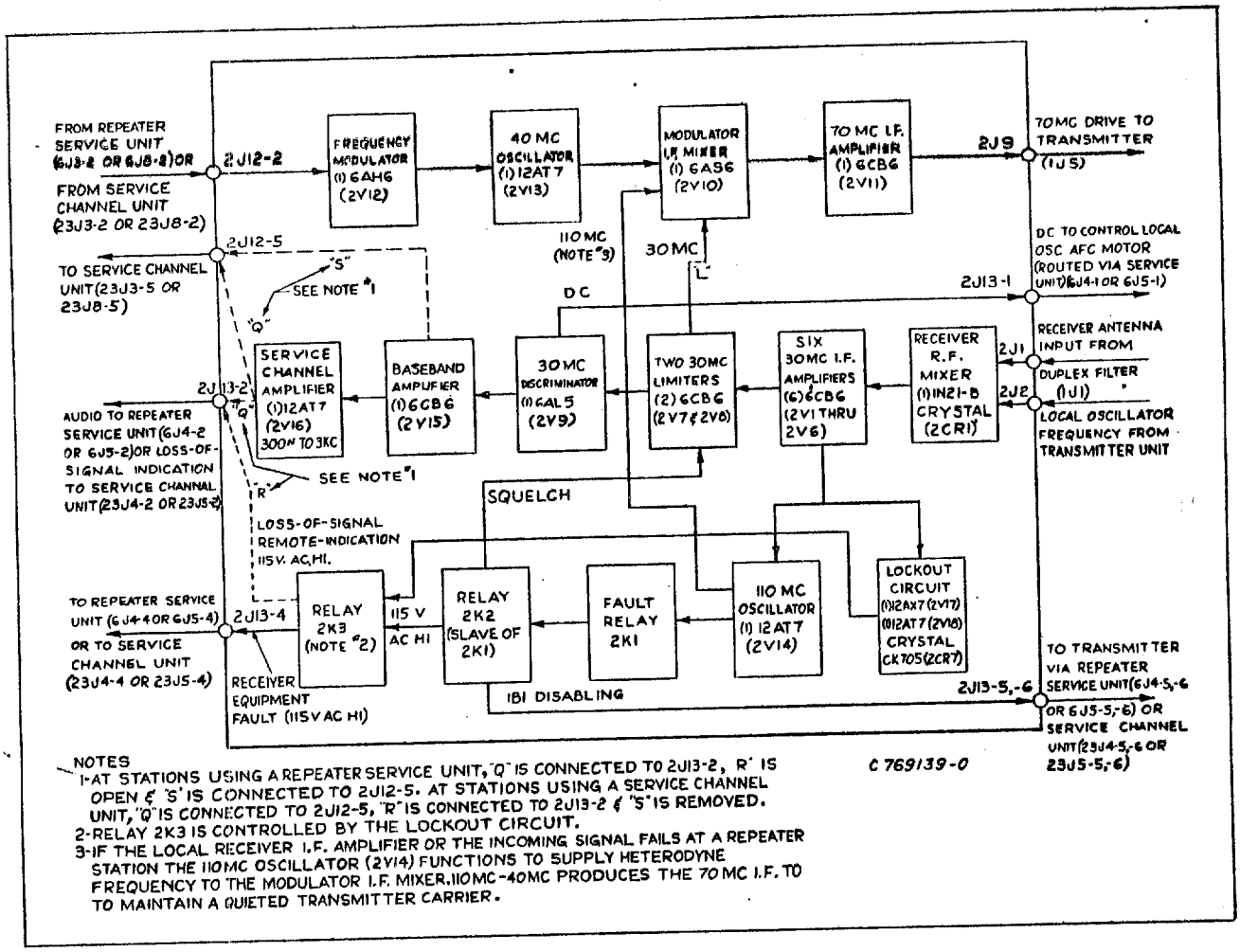


Figure RM-3—Receiver/Modulator—Block Diagram—Drop Repeater Station



NOTES
1-AT STATIONS USING A REPEATER SERVICE UNIT, "Q" IS CONNECTED TO 2J13-2, "R" IS OPEN & "S" IS CONNECTED TO 2J12-5. AT STATIONS USING A SERVICE CHANNEL UNIT, "Q" IS CONNECTED TO 2J12-5, "R" IS CONNECTED TO 2J13-2 & "S" IS REMOVED.
2-RELAY 2K3 IS CONTROLLED BY THE LOCKOUT CIRCUIT.
3-IF THE LOCAL RECEIVER I.F. AMPLIFIER OR THE INCOMING SIGNAL FAILS AT A REPEATER STATION THE 110MC OSCILLATOR (2V14) FUNCTIONS TO SUPPLY HETERODYNE FREQUENCY TO THE MODULATOR I.F. MIXER. 110MC-40MC PRODUCES THE 70 MC I.F. TO TO MAINTAIN A QUIETED TRANSMITTER CARRIER.

Figure RM-4—Receiver/Modulator—Block Diagram—Thru Repeater Station

present in the i-f amplifier is prevented from reaching the multiplex equipment and service units and from being transmitted.

3. Contact 5-7 opens. This breaks the 115 v ac supply to AFC motor 1B1 in the transmitter, disabling it for the duration of the operation of relay 2K2.

4. Contact 6-7 closes and connects one side of the 115 v ac supply to terminal 3 of relay 2K3.

Relay 2K3 Operation (Lockout Circuit)

The lockout circuit consists of several stages of audio (noise voltage) amplification 2V17 (1-2-3), 2V17 (6-7-8) and 2V18 (1-2-3), a crystal rectifier 2CR7, a d-c amplifier 2V18 (6-7-8) and d-c relay 2K3. The action of the lockout circuit is controlled by the voltage present at the junction of resistors 2R21 and 2R127 or for reference purposes at the more easily identified SIG jack 2J4.

Receiver Equipment Fault

If the i-f amplifier fails to function normally, the d-c voltage present at 2J4 drops sufficiently to cause relay 2K1 to operate relay 2K2, closing contact 6-7. Any noise voltage present at 2J4 is too weak to activate the lockout circuit so relay contact 2-3 of relay 2K3 is closed (2K3 not operated). This condition completes the 115 v ac circuit to the fault reporting equipment and to the switching unit at stations that have standby facilities, thereby initiating the report of a receiver failure and at standby stations the switchover to the standby radio equipment.

Loss-of-Signal Remote-Indication

A loss-of-incoming-signal condition causes a decrease of the dc voltage at 2J4 sufficient to operate relays 2K1 and 2K2. It also causes an ac noise voltage at 2J4 which is impressed on 2V17-2, am-

plified through three audio stages, rectified by diode 2CR7 and impressed on the grid of d-c amplifier 2V17 (6-7-8). The resultant plate current flow operates lockout relay 2K3. Contact 2-3 breaks, opening the 115 v ac circuit to the switching unit at standby stations, thereby preventing switchover. Contact 3-4 closes, completing the 115 v ac circuit through 2J13-2 to Service Channel Unit MI-31140, Coder Unit MI-31138 or Decoder Unit MI-31139 thus reporting a loss-of-signal remote-indication. At standby and indicon service channel system stations tubes 2V17, 2V18 and relay 2K3 are always required. At non-standby stations using Repeater Service Unit MI-31495 or Terminal Service Unit MI-31496, tubes 2V17, 2V18 and relay 2K3 are omitted and connection "T" ties pins 2 and 3 of 2X19 together. This connection is necessary for the proper operation of the receiver equipment fault circuit at stations using MI-31495 or MI-31496.

CONTROLS

a. The Cavity Tuning control (2Z1) is used to tune the mixer cavity to the frequency of the incoming signal.

b. The REL. OSC. control (2R46) adjusts the grid bias of the dc amplifier section of 2V14 thereby controlling the condition under which the tube will conduct and 2K1 will operate.

c. The DISC pin jack (2J5) is used to connect test meter 1M1 to the output of the discriminator to determine if the i-f frequency is centered at 30 mc.

d. The SIG. pin jack (2J4) is used to connect the test meter 1M1 to measure the signal voltage of the i-f section when tuning the receiver.

e. The CUR. (2J14) pin jack is used to connect the test meter 1M1 when tuning the 40 mc f-m osc. of the modulator section.

f. The FREQ. (2J7) pin jack is used to connect the distortion and modulation test unit to the modulator while aligning the receiver.

g. The XTAL. CUR. pin jack (2J3) is used to connect the test meter 1M1 when adjusting 2J2 of the mixer cavity for proper crystal excitation.

h. The 110 MC INPUT (2J8) coaxial terminal is used to connect the 110 mc output of the terminal AFC unit to the receiver r-f mixer grid. It is used only at terminal stations.

i. The 70 MC OUTPUT coaxial terminal (2J9) is used to connect the 70 mc output of the modulator section to the transmitter 70 mc input.

j. The LOCAL OSC coaxial terminal (2J2) is the input terminal for connecting a portion of the output of the transmitter local oscillator to the mixer cavity.

k. The Receiver Baseband Gain control 2R107 is a screw driver adjusting potentiometer for regulating the signal voltage level from amplifier stage 2V15 to the baseband unit and to the signal channel amplifier stage 2V16. This control, located in the rear of the unit, is adjusted and sealed at the factory and normally requires no adjustment in the field.

l. The Modulator Gain control 2R109 is a screwdriver adjusting potentiometer for controlling the amount of signal voltage from the baseband unit applied to the 40 mc modulator stage 2V12. This control, located in the rear of the unit, is adjusted and sealed at the factory and normally requires no adjustment in the field.

m. The NOISE GAIN potentiometer 2R115 is a control for regulating the amount of noise signal to amplifier 2V17 (6-7-8).

n. The "OPR CUR" jack 2J15 is for monitoring the operating current of the dc amplifier 2V18 (6-7-8) when adjusting the noise gain control.

o. The TUBE CHECK pushbutton 2S1 is used to reduce the filament voltage of the tubes for the purpose of checking their operating condition.

p. The SERV CHAN GAIN control 2R140 is used to adjust the input to the service channel amplifier 2V16.

MAINTENANCE

General Notes

The majority of tubes in the receiver/modulator can be checked while the unit is in operation by use of TUBE CHECK pushbutton 2S1. With the unit operating normally connect SIG jack 2J4 to test meter 1M1 and note the current reading. If this reading drops more than 50% when 2S1 is depressed there is a near-failure tube probable in one of the first five 30 mc i-f sockets (2V1 thru 2V5). If the current read at the 40 mc OSC CUR jack drops more than 20% with 2S1 depressed it is probable that either 2V12 or 2V13 are near failure. If this check is satisfactory, a check of 2V10 and 2V11 is possible by observing the rf monitor meter 1M2 reading. If its reading drops more than 60% a near-failure tube is probable in sockets 2V10 or 2V11. A check of 2V6 thru 2V9 and 2V15 is possible by monitoring a received

multiplex signal. If the level of this signal varies more than ±2 db a probable near-failure tube exists in one of these sockets.

Regarding changing tubes in the receiver/modulator it should be cautioned that certain tubes should be replaced only if absolutely necessary. 2V8 (2nd Lim.), 2V9 (Discr.), 2V12 (Mod.), and 2V13 (Osc.) have effects upon the modulation and demodulation linearity of the system. As a consequence these should not be changed unless complete tube failure makes it necessary.

The changing of these tubes may affect the linearity of these stages. Do not attempt a linearity realignment unless the cross talk between channels is noticed to increase intolerably. See the CIRCUIT ALIGNMENT section following, if linearity alignment is required.

If either 2V12 or 2V13 are changed, the frequency of the 2V13 oscillator should be adjusted to 40 mc by varying 2L57 "40 MC OSC" only. When measuring the frequency of the 40 mc oscillator there must be no modulation on it. To make sure there is no hum input, pull out the baseband plug feeding the receiver/modulator during the measurement. If 2V14 is changed the frequency and operating point of the 110 mc oscillator will need to be rest.

The information required for checking and adjusting the frequency of the 40 mc and 110 mc oscillators will be found in the INITIAL ADJUSTMENT procedure of the system instructions and the CIRCUIT ALIGNMENT section following.

When *replacing a 1N21B Crystal,* caution must be exercised to prevent damaging the crystal by static discharge. To prevent this, one hand should be grounded to the chassis before the crystal is allowed to touch any part of the equipment. A soldering iron should never be used on circuits connected to the 1N21B crystal without unplugging the iron for the period of use. AC leakage current may otherwise burn out the crystal. The 1N21B crystal current should never be allowed to exceed a meter reading at 2J3 of 200 μa.

If a tuning coil in the 30 mc i-f or 70 mc i-f circuits should open or become damaged, install a replacement coil with its core turned in the same amount as in the faulty coil. When thus repaired these circuits will be adequately well aligned.

Tuning coils of the frequency modulator stages 2V12 or 2V13 and discriminator stage 2V9 cannot be replaced without alignment of those circuits.

The plug-in electrolytic capacitor 2C71 should be replaced after being in use continuously for one year.

The schematic of figure RM-11 shows the dc voltage values at all pertinent circuit check points. Certain of these points contain double voltage readings. Wherever these readings occur, except for standby lockout circuit 2V18, the value above the line is the voltage with no signal at the receiver input and the value below the line is present with a saturating signal. For 2V18 the upper value is for little or no signal and the lower value is with tube 2V1 removed.

CIRCUIT ALIGNMENT

The following instructions describe the process for complete realignment of a receiver/modulator unit. It is strongly cautioned that before such a realignment be attempted full familiarity with the unit be obtained and all of the recommended test equipment listed in the test equipment tables of the system instructions be assembled.

The test items specified in the following alignment procedures refer to the test equipment items listed in the test equipment tables of the system instructions.

Limiter Alignment

a. Remove 2CR1. Attach the sweep generator output to the junction of 2C42 and 2C45; attach the scope lead to the junction of 2L40 and 2R37; attach test equipment item 27(a) between ground and 2C139. Set the sweep generator output low enough so that the stage has not started to limit and the scope response is sharp. Peak 2L35 at 30.0 mc.

NOTE: In this and other applications, use a 10 microhenry r-f choke with leads approximately one inch long (test item 27(d)) in series with the scope lead.

b. Repeat the above, peaking 2L31 with the sweep generator attached to the high side of 2L27 and the scope attached to 2V7-6. Remove test equipment item 27(a).

30 MC IF Alignment

a. Remove the rubber base cement used to prevent the cores of the i-f transformers from moving. Use a sharp instrument to loosen the edge of the seal and then peel off the cement.

b. Apply the output of the 30 mc sweep generator to the bottom end of 2L22, ground pin 1 of 2V4 to the center pin of the socket with a test prod, and attach the scope to the junction of 2C37 and 2R21. Adjust the output of the sweep generator for

approximately +0.2 v dc at 2R21 with the "sweep" knob in the "narrow" position. Turn on the sweep generator markers at 25.6 mc and 34.4 mc. With the "sweep" knob in the "wide" position, align the stage for symmetrical response, (stages will vary from critical coupled to somewhat less than critical coupled) and for band-width such that the two markers fall on the 50% response point. It will be found that 2L25 and 2L27 act much the same as the primary and secondary respectively of a double-tuned circuit. 2L26 controls the primary-to-secondary coupling and consequently the stage bandwidth.

NOTE: Solder a 100 K ohm isolation resistor in series with the Voltohmyst test probe.

c. Connect the sweep generator to 2L17, ground 2V3-1, connect test equipment item 27(c) (see figure RM-6) to the bottom end of 2C27, and attach the scope to the alignment jig. With the scope gain on maximum, adjust the sweep generator output for the minimum value providing an adequate picture. Align 2L20, 21 and 22 as above except place the 25.6 mc marker at the 60% response point and the 34.4 mc marker at the 40% response point as shown in figure RM-5.

This is done so that when the slight capacity added by the alignment jig is removed, the stage will be properly centered around 30 mc.

d. Apply the sweep generator to 2L12, ground 2V2-1, attach the alignment jig to the bottom of 2C21, and apply capacitor test equipment item 27(e), to 2V5-5 so as to ground this point to r-f only. Align 2L15, 16 and 17 as in (c).

e. Align 2L10, 11 and 12 as in (d) by moving all test equipment items forward one stage.

f. Attach the 680-ohm - 47 ohm resistor combination, test equipment item 27 (b) (see figure RM-8), between the screw directly above 2L3 and the standoff insulator connection to 2L1.

Align 2L5, 6 and 7 as in (d) by moving all test equipment items forward one stage except apply sweep generator through a 1500 mmf ceramic capacitor to 2V1-1.

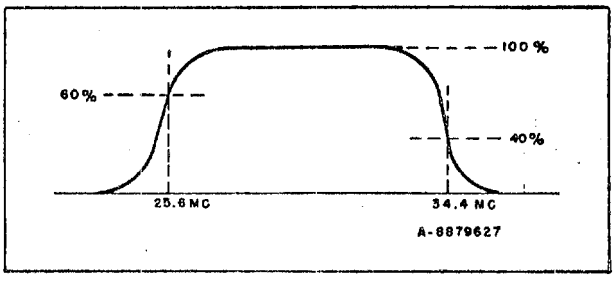


Figure RM-5—30 mc IF Response Curve

g. Attach the sweep generator to the high side of the 47 ohm resistor, the scope to the junction of 2L3 and 2R86 and r-f ground 2V2-5. Align 2L1, 2 and 3 for a flat-topped response regardless of the stage bandwidth unless this bandwidth is less than 8.8 mc. In this latter case align for 8.8 mc bandwidth.

Since the alignment jig is not used in this case the stage is to be aligned symmetrically about 30 mc as in (b) with the two markers at the same percentage response.

Remove test equipment item 27(b).

h. To insure that the limiter interstages are acting as limiters, connect the sweep generator to 2L22, the scope to the junction of 2L40 and 2R37, and test equipment item 27(a) to 2C139. Starting with a low enough sweep generator output so that the picture viewed is a sharply peaked response, increase the output and observe that the response broadens out and reaches a limiting value. Repeat with the scope on 2V7-6.

NOTES: 1. To minimize spurious interstage coupling, the ground return connection of the sweep generator should always be kept to the left of the point at which the sweep generator is being applied (as viewed from the rear of the chassis).

2. The sweep generator output cable is to be terminated in 68 ohms at the cable end. The leads from the end of the cable to the point of use should be kept as short as possible—certainly under 2".

3. To obtain an i-f response centered around 30 mc, it may be necessary to slightly favor either band edge marker at the expense of the other. Depending upon how well the results of test (b) (IF Response Check) indicate i-f symmetry, a touch method for tuning the i-f's a bit high or low may need to be used.

R-F Test and I-F Gain Check

Insert 1N21B crystal.

CAUTION: Ground the body to the receiver chassis before inserting the crystal to prevent static discharge from damaging the crystal.

a. Apply the transmitter local oscillator frequency to 2J2. Adjust the position of 2J2 for 2J3I = 50μa. With no input signal to the i-f or r-f note the value of 2J4E due to amplified noise. If this reading is below 0.1 volt, the i-f has insufficient gain and the quality of the i-f tubes should be investigated. The 0.1 volt reading is equivalent to a reading of 5 μa using the 200 μa test meter.

b. Maintaining the local oscillator feed at 2J3I = 50 μa attach test equipment item 16, the

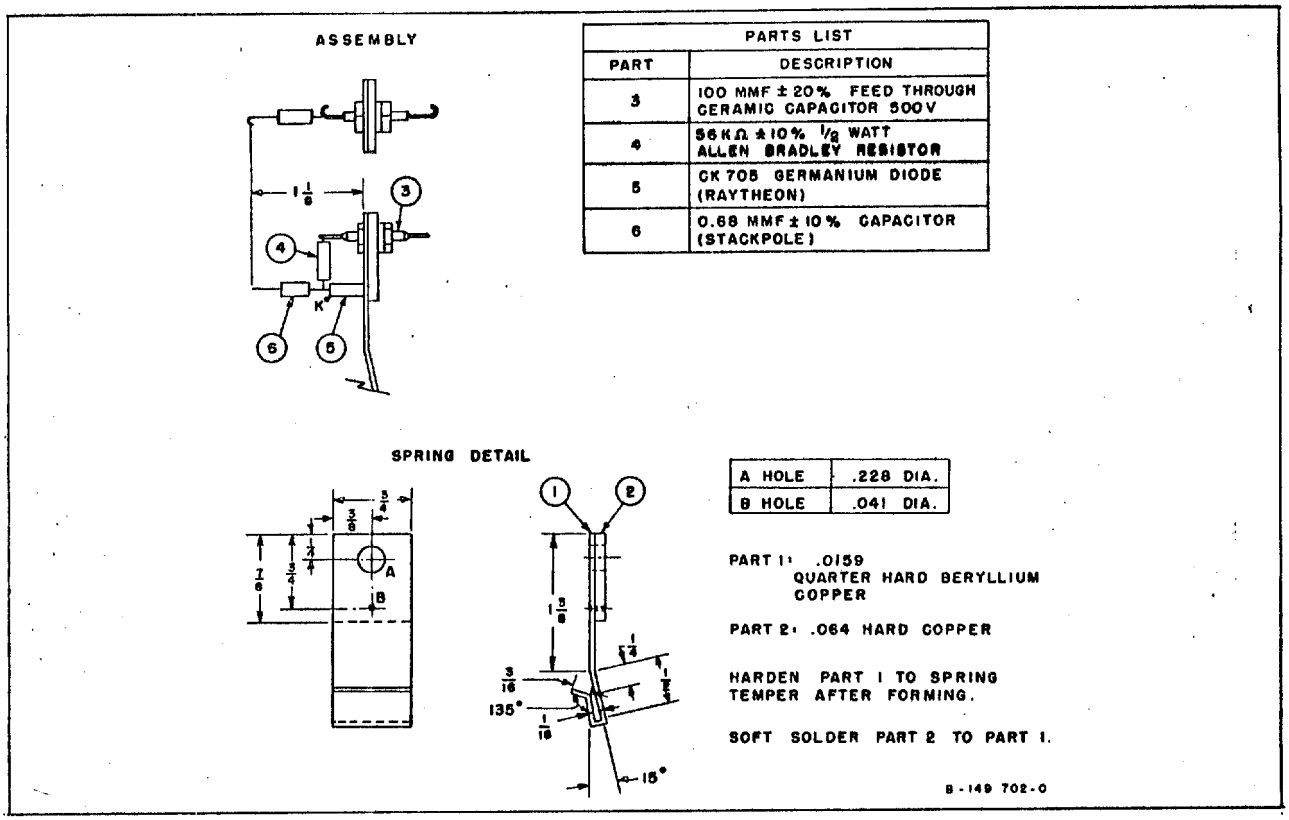


Figure RM-6—30 mc IF Alignment Jig

r-f signal generator. Note the reading of 2J4E on noise with the signal generator off. Turn on the signal generator and adjust its frequency to that normally received. Fine tuning is accomplished by tuning for zero discriminator current (2J5). Increase the 2J4E reading by the noise figure factor listed below (depending upon the original noise reading).

2J4E on Noise	*Noise Figure Factor*
.05 v to 0.1 v	1.6 x
0.1 v to 0.4 v	1.5 x
0.4 v to 0.8 v	1.4 x

Note the signal generator reading in microvolts. It should be equal to or less than 4.2 μv. This figure corresponds to a noise figure of 12.0 db.

NOTE: For all of these tests a short, low loss r-f cable must be used to connect the r-f test equipment to the receiver.

I-F Response Check

a. Calibrate the discriminator (with the i-f cover on) by applying high level, saturating signals to the i-f at 28, 30 and 32 mc, recording the discriminator voltage for those frequencies.

Connect the r-f signal generator to 2J1 and apply a signal at the frequency of the assigned received signal. Adjust its exact frequency so that the i-f frequency is 30.0 (0 current at 2J5) mc and adjust the level for 2J4E = 1.0 v. Adjust the slug of 2Z1 for a peak reading. Vary the signal generator frequency (keeping its output constant) and note 2J4E for i-f signals of 28.0 mc and 32.0 mc. The i-f response in db, defined as

$$20 \log_{10} \frac{E(28 \text{ mc or } 32 \text{ mc})}{E(30 \text{ mc})}$$

should not vary from the 30 mc value by more than ±1.5 db.

NOTE: In this case and others when a saturating 30 mc i-f signal is desired, the maximum output of the i-f signal generator will suffice. It should be fed into the i-f strip through the hole in the cover just above the hole for the tuning slug of 2L2.

70 mc I-F Alignment

a. Connect the "70 MC OUTPUT" of the receiver/modulator to the 70 mc jack of test equipment item 27(f) (see figure RM-7) using the 70 mc coaxial cable that is normally connected to the Transmitter "70 MC INPUT." (No other cable

should be used.) Attach the scope to the "d-c" pin of test item 27(f) (70 mc dummy load) and the sweep generator, with 70 mc sweep at full output, to 2V11-1. Align the output network, by tuning 2L55 and 2L56 so that the response is symmetrical and the 64 mc and 76 mc pips fall at the 70% response point.

b. Connect the sweep generator to the hot end of 2L50. With the scope still on "d-c", reduce the output of the sweep generator until the observed scope picture height is roughly the same as it was in (a). Connect the scope to 2V11-6. Align 2L52, 53 and 54 as above for symmetrical response and for pips at the 70% response points.

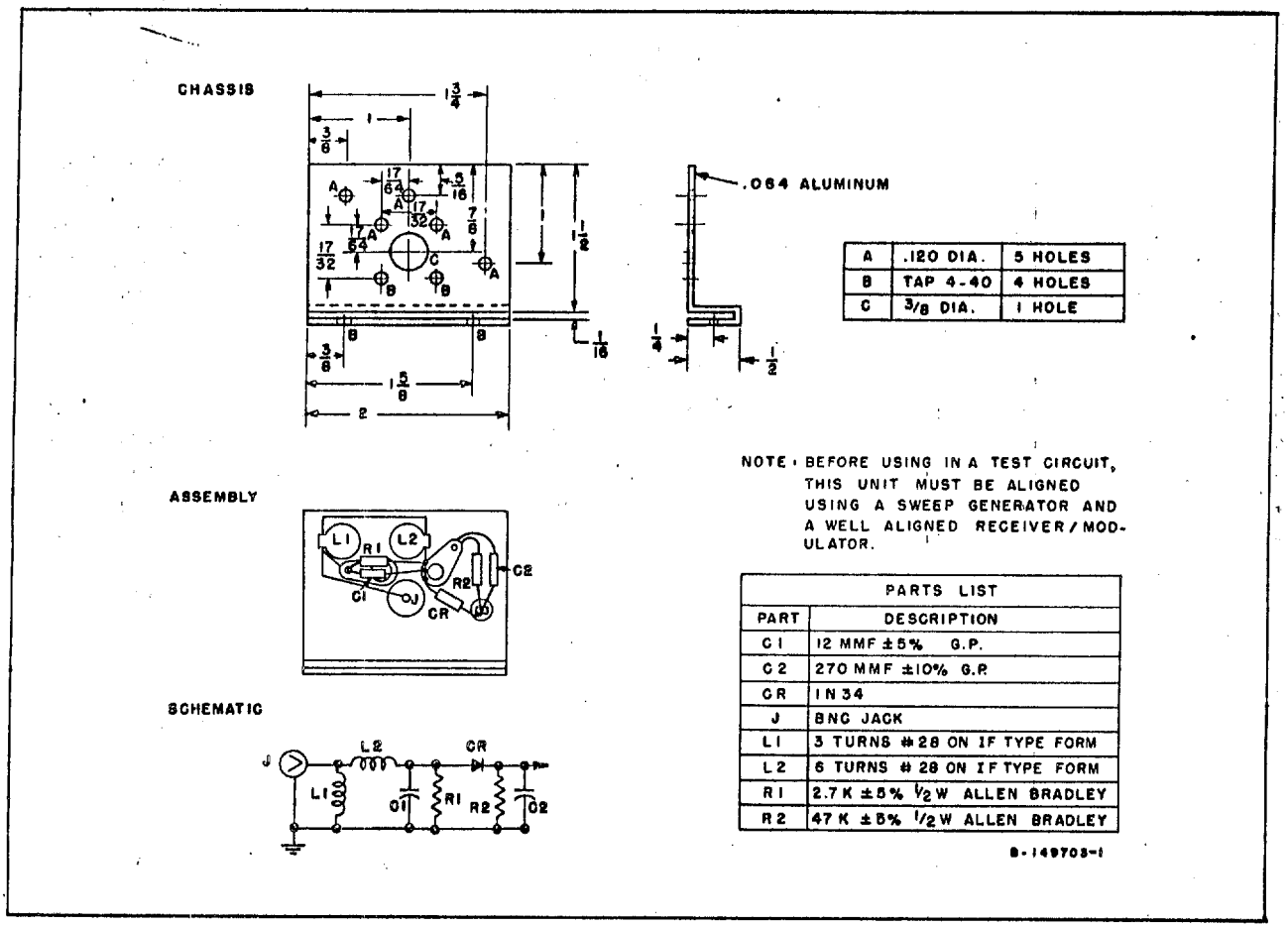
Mixer Circuit Alignment

Using the megacycle meter (test equipment item 12) adjust the 40 mc oscillator (2V13) so that its frequency is 40.0 mc. Make sure that 2J14I (as measured with the 200 μa meter, test item 14) is reading a reasonable value—between +65 μa and +80 μa. Apply a 30.0 mc saturating signal to the 30 mc i-f. Metering the voltage at the "d-c" terminal of 70 mc dummy load, peak 2L49 and 2L50. This must be done very carefully since the maxima are quite broad. The rectified dummy load dc voltage should be 1.5 volts or greater. *Wire "L" must be connected for this test.*

Fault Oscillator/Relay Adjustment

a. Turn 2R46 maximum clockwise to insure strong oscillation of 2V14. Using the megacycle meter (test item 12) set the oscillator frequency to 110 mc. The rectified dummy load dc voltage should be 1.5 volts or greater.

b. To adjust the REL/OSC CONTROL 2R46 connect the r-f signal generator (test item 16) to 2J1. With the signal generator at zero output, plug the 1M1 meter lead into the SIG jack and note the noise reading on the test meter. Turn up the signal generator output until a reading of 20 μa plus the noise reading is obtained. Then turn the REL/OSC CONTROL fully clockwise and then carefully counter-clockwise, stopping when the



A	.120 DIA.	5 HOLES
B	TAP 4-40	4 HOLES
C	3/8 DIA.	1 HOLE

NOTE: BEFORE USING IN A TEST CIRCUIT, THIS UNIT MUST BE ALIGNED USING A SWEEP GENERATOR AND A WELL ALIGNED RECEIVER/MODULATOR.

PARTS LIST	
PART	DESCRIPTION
C1	12 MMF ±5% G.P.
C2	270 MMF ±10% G.P.
CR	1N34
J	BNC JACK
L1	3 TURNS #28 ON IF TYPE FORM
L2	6 TURNS #28 ON IF TYPE FORM
R1	2.7K ±5% 1/2W ALLEN BRADLEY
R2	47K ±5% 1/2W ALLEN BRADLEY

B-149703-1

Figure RM-7—70 mc Dummy Load

relay clicks. The relay should now operate and the 110 mc oscillator become operative and inoperative as the signal is removed and reapplied.

Discriminator Alignment

a. *Remove wire "L."* Turn controls 2R107 and 2R109 on the receiver/modulator unit to maximum. Attach the distortion and modulation test unit, test equipment item 11, to the receiver/modulator, putting only the 30 mc probe and the 40 mc probe in place. With the "40 mc Var" oscillator, and "40 mc Xtal" oscillator on, locate the beat between the two with the "40 mc Var" control. Note dial reading. With "40 mc Xtal" oscillator off, adjust 2L57 until the 2V13 oscillator beats with the "40 mc Var" oscillator. Turn off the "40 mc Var" oscillator.

NOTE: For all of this test the covers for both the 30 mc i-f and the oscillator-mixer section must be kept on.

b. Plug in the baseband connection. Apply the transmitter local oscillator frequency to 2J2. Adjust the position of 2J2 for 2J3I = 50 μa.

Each distortion and modulation test unit is factory adjusted so that its meter (M1) will read 100 for ±750 kc deviation when the meter is on the "35 mc Osc" position at which time it reads the tone level being supplied to the 35 mc modulator/oscillator. For an average modulator section (in the receiver/modulator unit) a reading of 60 will result in a ±750 kc deviation, with the meter switch on the "Rec-Mod" position.

Put the operation switch in the "Discr" position. With meter on "35 mc Osc." adjust Osc. B on 50 kc for a reading of 100. With the meter on "Rec. Mod." adjust Osc. A on 70 kc for a reading of 60. With the meter on 0 db and Osc. B changed to 30 kc, adjust "30 kc Gain" for full scale (0 db) reading. With Osc. A on the 70 kc and 80 kc positions, and Osc. B on 50 kc read the intermodulation products at 30 kc with the meter. In the 70 kc and 80 kc positions the unit is measuring the products due to third and second order intermodulation respectively. Adjust the discriminator so that both 70 kc and 80 kc products are minimum. It should be possible to align the units so these products are below –43 db, however a value of –40 db will provide satisfactory service.

In aligning the discriminator it will be found that 2L41 primarily adjusts the high frequency peak and 2L42 primarily adjusts the low frequency peak. The 70 kc product is determined by the separation of these two peaks and the 80 kc product is determined primarily by the 2L40 tuning.

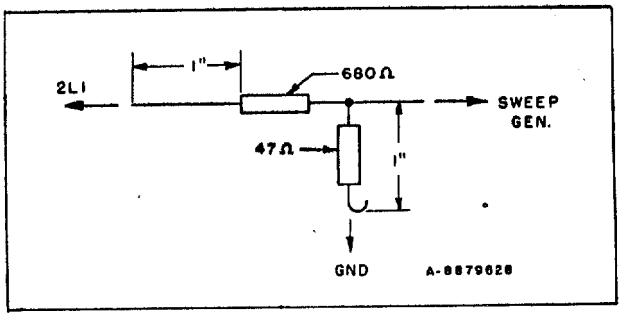


Figure RM-8—30 mc Alignment Resistor Network

During this and the remaining intermodulation tests, the discriminator (2J5) reading must be kept on zero (±0.1 v) by varying the frequency of the test unit 35 mc oscillator after first ascertaining that the 40 mc oscillator is on frequency. Also, in tuning the discriminator the condition shall be maintained that: *the discriminator d-c output for a saturating CW signal of 30.0 mc must be zero volt ±0.1 v.*

c. Test the discriminator linearity at half deviation using essentially the same procedure as above, except use readings of ½ the above for the oscillator levels. (Readjust the "30 kc Gain" for full scale reading in this revised condition.) It should be possible to align the units so that in this case the products will be below –51 db, however, a value of –45 db will provide satisfactory service.

Modulator Alignment

a. Continuing with the test unit, change to the "overall" test position. With the meter on "Rec Mod", "Osc. A" off and "Osc. B" on 50 kc adjust the output of "Osc. B" to 60. With "Osc. B" off and "Osc. A" on 70 kc adjust its output to 60. With both oscillators on and Osc. B on 30 kc, adjust "30 kc Gain" for full scale on meter "O db". With "Osc. A" on 80 kc, tune 2L58 for minimum meter reading. Check the meter reading with oscillator A on 70 kc. It should be possible to align the units so that these products are below –43 db, however a value of –40 db will provide satisfactory service.

b. Test the overall operation at half deviation using essentially the same procedure as above except using a meter reading of 30. (Readjust "30 kc Gain" for full scale.) It should be possible to align the units so that in this case the products will be below –51 db, however a value of –45 db will provide satisfactory service.

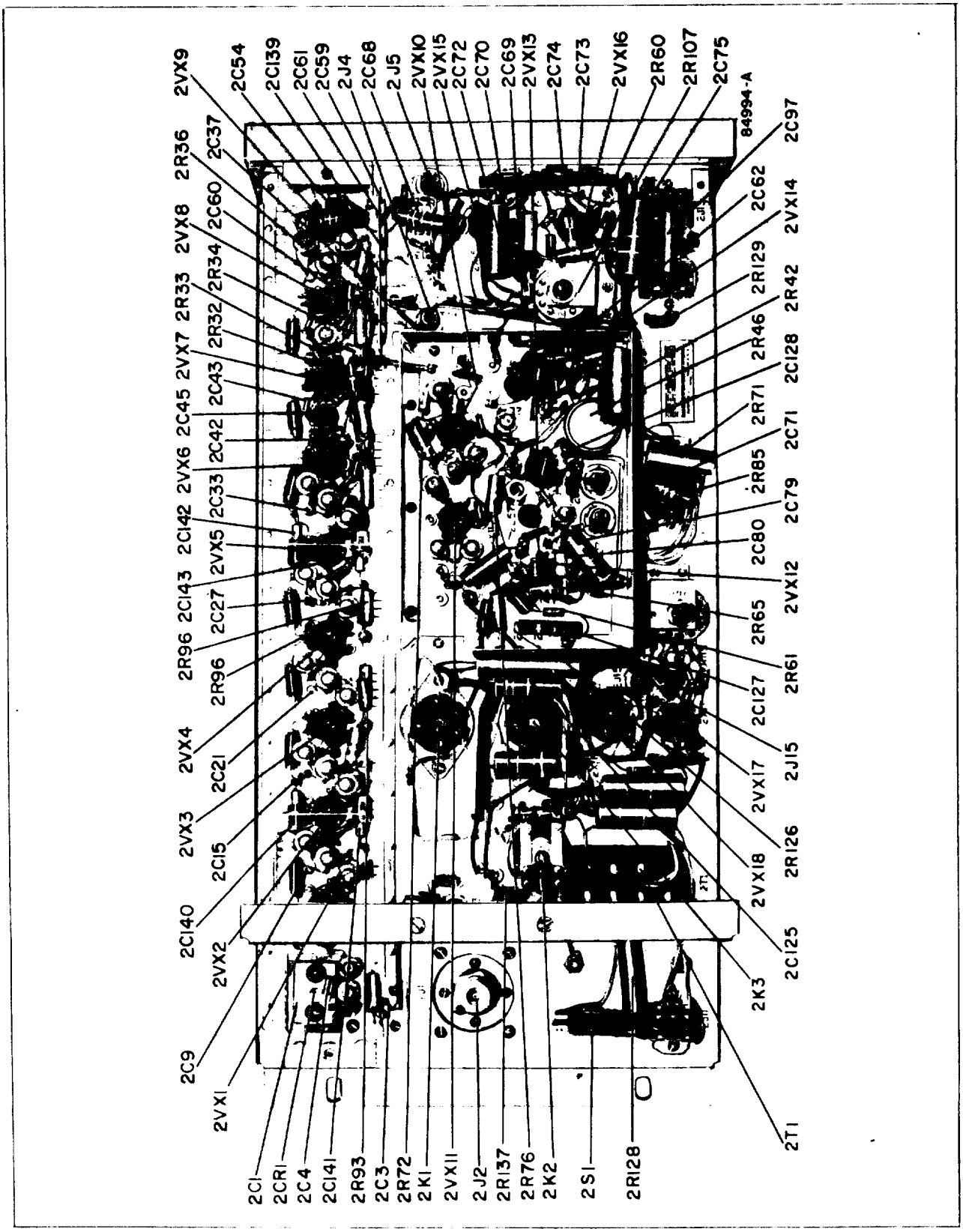


Figure RM-9—Receiver/Modulator—Rear View, Dust Cover and Shield Covers Removed

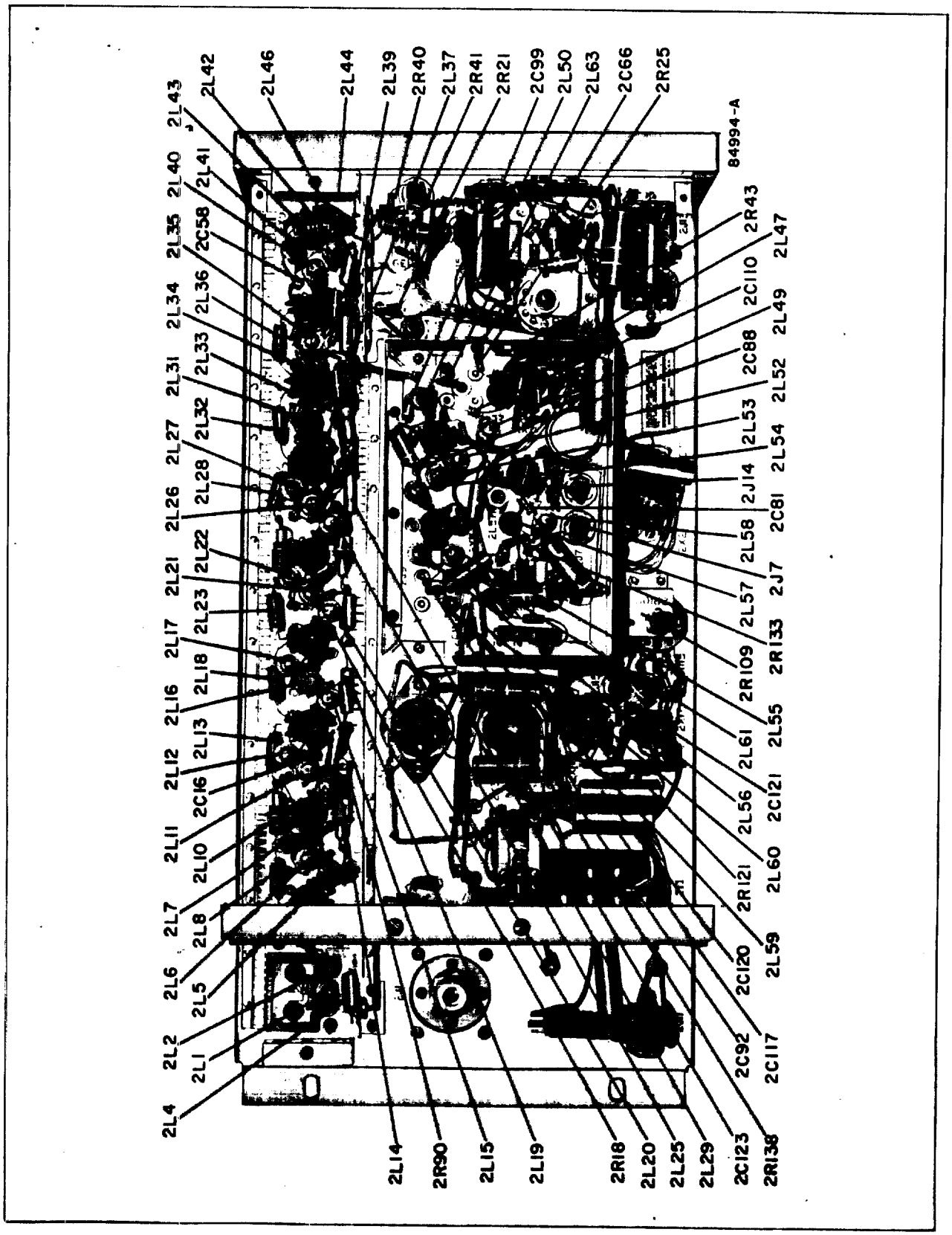


Figure RM-10—Receiver/Modulator—Rear View, Dust Cover and Shield Covers Removed

NOTES: 1. Since an average reading of 60 is used for the receiver 40 mc modulator, occasionally difficulty may arise due to over-deviating an unusually sensitive modulator. If there is doubt, calibrate the individual modulator as is generally described in (c) below.

2. In all discriminator and modulator alignment tests the 200 μa test meter must *not* be connected to 2J5.

c. Connect the electronic voltmeter test equipment item 3 between 2J12-2 and ground on the receiver/modulator. Using the test unit "40 mc Var" oscillator as a deviation meter, set the test switch to the OVERALL position, turn Osc A off, Osc B on 30 kc and adjust the 30 kc level until the peak deviation is exactly ±750 kc. Measure the required modulator input. Limits 0.24 v to 0.37 v rms. Note the test unit meter current reading and use this value in place of the average value of 60.

Baseband Amplifier Check

a. Maintaining the conditions above, meter the 30 kc voltage on 2J12-5. Limits 0.75 v to 1.5 v.

TYPICAL RECEIVER/MODULATOR VOLTAGE AND METER READINGS

The following are approximate voltages existing between individual tube pins and ground as measured with the Voltohmyst with a 110k resistor in series with the probe. In the case of signal-dependent voltages the left-hand value is for no signal and the right-hand value for high signal. All voltages are dc unless otherwise noted.

Tube	*Type*	*Function*	*Pin #1*	*Pin #2*	*Pin #3*	*Pin #4*	*Pin #5*	*Pin #6*	*Pin #7*	*Pin #8*	*Pin #9*
2V1	6CB6	I.F.	–.20	0	6.1 ac	0	60	60	0	—	—
2V2	6CB6	I.F.	0	1.0	6.1 ac	0	80	80	0	—	—
2V3	6CB6	I.F.	0	1.0	6.1 ac	0	80	80	0	—	—
2V4	6CB6	I.F.	0	1.0	6.2 ac	0	80	80	0	—	—
2V5	6CB6	I.F.	0,–1.6	1.2,1.3	6.2 ac	0	80,70	80,70	0	—	—
2V6	6CB6	I.F.	0,–2.0	1.2,1.3	6.2 ac	0	80,65	80,65	0	—	—
2V7	6CB6	I.F.	0	3.0	6.3 ac	0	100	100	0	—	—
2V8	6CB6	I.F.	0	2.5	6.3 ac	0	100	107	0	—	—
2V9	6AL5	Disc.	0	–3.4	0	6.3 ac	var.	0	–3.4	—	—
2V10	6AS6	Mixer	–1.8,–.03	.85,.55	6.3 ac	0	33,64	33,64	0	—	—
2V11	6CB6	Amp.	0	1.4	6.3 ac	0	100	100	1.4	—	—
2V12	6AH6	Mod.	3.5	7.0	6.3 ac	0	160	135	7.0	—	—
2V13	12AT7	Osc.	160	2.7	4.4	0	0	160	+2.7	4.4	6.3 ac
2V14	12AT7	Osc/Relay	26,12	0.1,2.7	2.5	0	0	215,250	26,12	32,24	6.3 ac
2V15	6CB6	B.B.Amp.	3.2	4.1	6.3 ac	0	210	65	4.1	—	—
2V16	12AT7	S.Ch.Amp.	75	0	1.5	0	0	165	0	1.8	6.3 ac
2V17	12AX7	Lockout Amp.	125	0	1.5	0	0	125	0	1.5	6.3 ac
2V18	12AT7	Lockout Amp.	90	–3.0,0	2.0	0	0	200,250	33.0	35,15	6.3 ac

Voltages are positive unless noted. Var.—variable with received frequency.

The following are typical readings obtained using the 200 microamperes test meter (1M1) in the transmitter unit.

Xtal Cur.	(2J3):	–50 μa
Sig.	(2J4):	+5 μa no signal; +140 μa high signal
Disc.	(2J5):	zero for 30.0 mc I. F. signal; up to ±150 μa for off freq. signal. A typical value is ±30 μa for carrier frequencies different from 30 mc by ±1 mc.
Grid Cur.	(2J14):	+70 μa
Lockout Cur.	(2J15):	110 μa with no signal or low signal 55 μa with 2V1 removed from the socket

NOTE: The components affecting this output include 2V8. If it is necessary to change 2V8 in order to pass the above test, (b) and (c) of Discriminator Alignment must be redone. As an aid to isolating low baseband output difficulties, it may be desirable to note the discriminator deviation sensitivity. This has been found to average around 0.4 v rms for a peak deviation of ±0.75 mc. This voltage is measured at 2C61 with the electronic voltmeter. A 10 microhenry choke must be used in series with the hot lead of the electronic voltmeter.

Baseband Gain Control and Modulator Gain Control Adjustments

a. Maintain the distortion and modulation test unit set up as above, except remove the lead feeding the baseband output (2J12-5) to the test unit. Place a 22,000 ohm resistor between 2J12-5 and ground to properly terminate the baseband output.

b. Using the distortion and modulation test unit 35 mc modulated oscillator or some other source of standard deviation, calibrate the discriminator determining what ac voltage it delivers when the i-f signal is deviated ±1.5 mc.

c. Apply a 5 kc tone at a level of 0.85 volts to 2J12-2. Adjust the modulator gain control 2R109 until the discriminator voltage is the value measured in (b) above.

d. Measure the voltage between 2J12-5 and ground and adjust the baseband gain control 2R107 for 1.2 volt output.

Service Channel Amplifier Check

Apply a voltage at 1 kc from test equipment item 2 to 2J12-2 at a level of 0.0425 v rms. This will deviate the oscillator by ±75 kc. The service channel output from 2J13-2 into 10k ohms should then be greater than 7 volts with 2R140 at its maximum clockwise position. Adjust 2R140 for a 7 volt output. Remove the resistors placed between 2J12-5 and ground and between 2J13-2 and ground.

For additional information on the use of the Distortion and Modulation Test Unit MI-31023-A (test item 11) consult the instructions supplied with the unit.

If the receiver/modulator unit is to be used in a terminal station remove wire "L". Retain this connection if the unit is to be used in a repeater station. Apply core sealing material to the tops of all tuning coils except 2L47 and 2L57. Also seal 2R107 and 2R109.

Service Channel Options

In order that the stations will operate correctly when using either of the service channel and fault systems (Repeater Service Unit MI-31495 and Terminal Service Unit MI-31496 or Service Channel Unit MI-31140, Indicon Coder MI-31138 and Indicon Decoder MI-31139), the receiver/modulator unit must be correctly connected internally to accommodate the specific equipment used. Figure RM-11 contains the information for making these connections.

Lockout Circuit

The lockout circuit of the receiver/modulator unit is used at all standby stations and at non-standby stations using the indicon service channel system (Service Channel Unit MI-31140, Indicon Coder Unit MI-31138 and Indicon Decoder Unit MI-31139).

To test and adjust the lockout circuit of the receiver/modulator perform the following steps:

1. Remove the rf signal from the receiver/modulator. Remove 2V1 and lockout relay 2K3.

2. Turn the "NOISE GAIN" potentiometer 2R115 fully clockwise. Note the current reading at the OPR CUR jack (the 0 to 200 μa test meter located in the transmitter may be used). The current should read between 40 and 60 μa.

3. Maintaining conditions as above, insert the lockout relay. The "OPR CUR" current should not rise more than 5 μa above the value noted in (2) above.

4. Maintaining conditions as above replace 2V1. The current at the "OPR CUR" jack should read between 110 and 190 μa.

5. Vary the "NOISE GAIN" potentiometer. Starting at the fully counter-clockwise position, note the OPR CUR reading at which the lockout relay just operates. This should be no more than 25 μa above the reading of (2) above. Adjust the "NOISE GAIN" for an "OPR CUR" reading of 110 μa.

NOTE: The current at the "OPR CUR" jack is dependent on the strength of the applied r-f signal. Therefore when an r-f signal is applied to the receiver/modulator the "OPR CUR" reading may drop from the 110 μa value

set above. With a very strong signal the current reading may drop to approximately the reading of (2) due to the saturation of i-f stage 2V5 which limits off the noise on the signal. Thus, when adjusting the "NOISE GAIN" control for the proper current reading it is important to remove the r-f signal from the receiver/modulator.

6. Check operation of the receiver/modulator relays and the lockout relay using the following table:

Condition	*B+ at 2V15-5*	*Voltage between 2J11-5 and 2J13-6*	*Voltage between 2J11-5 and 2J13-4*
With r-f signal	210 v dc	115 v ac	0
No r-f signal	0	0	0
2V1 removed	0	0	115 v ac

7. Restore the receiver/modulator to normal operating conditions.

REPLACEMENT PARTS LIST

Symbol No.	*Description*	*Drawing No.*	*Stock No.*
2C1	Part of 2Z1.		
2C2	Capacitor, fixed, ceramic, 1500 mmf +100 –0%, 500 v.	449696-3	73748
2C3	Capacitor, fixed, mica, 1000 mmf ±10%, 500 v.	984002-121	94189
2C4	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v.	735717-33	102015
2C5	Not used.		
2C6, 2C7	Capacitor, fixed, ceramic, 1500 mmf +100 –0%, 500 v. Same as 2C2.	449696-3	73748
2C8	Not used.		
2C9	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	102015
2C10	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v.	735717-427	93602
2C11, 2C12	Not used.		
2C13	Capacitor, fixed, ceramic, 1500 mmf +100 –0%, 500 v. Same as 2C2.	449696-3	73748
2C14	Not used.		
2C15	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	102015
2C16	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v. Same as 2C10	735717-427	93602
2C17	Not used.		
2C18	Capacitor, fixed, ceramic, 1500 mmf +100 –0%, 500 v. Same as 2C2.	449696-3	73748
2C19, 2C20	Not used.		
2C21	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	102015
2C22	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v. Same as 2C10	735717-427	93602
2C23	Not used.		
2C24	Capacitor, fixed, ceramic, 1500 mmf +100 –0%, 500 v. Same as 2C2.	449696-3	73748
2C25, 2C26	Not used.		
2C27	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	102015
2C28	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v. Same as 2C10	735717-427	93602
2C29, 2C30	Not used.		
2C31	Capacitor, fixed, ceramic, 1500 mmf +100 –0%, 500 v. Same as 2C2.	449696-3	73748
2C32	Not used.		
2C33	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	102015
2C34	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v. Same as 2C10	735717-427	93602
2C35	Capacitor, fixed, ceramic, 1500 mmf +100 –0%, 500 v. Same as 2C2	449696-3	73748
2C36	Capacitor, fixed, ceramic, 1500 mmf ±20%, 500 v.	8864187-2	204866
2C37	Capacitor, fixed, ceramic, 220 mmf ± 10%, 500 v.	984002-181	94222
2C38	Not used.		
2C39	Capacitor, fixed, ceramic, 1500 mmf +100 –0%, 500 v. Same as 2C2	449696-3	73748
2C40, 2C41	Not used.		

Symbol No.	Description	Drawing No.	Stock No.
2C42	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	102015
2C43	Capacitor, fixed, ceramic, 470 mmf ±10%, 500 v.	735717-37	94223
2C44	Not used.		
2C45	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v. Same as 2C10	735717-427	93602
2C46	Capacitor, fixed, ceramic, 1500 mmf +100 –0%, 500 v. Same as 2C2	449696-3	73748
2C47, 2C48	Not used.		
2C49	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	102015
2C50	Capacitor, fixed, headed lead, 4.7 mmf ±20%, 500 v.	99327-6	54402
2C51	Capacitor, fixed, ceramic, 470 mmf ±10%, 500 v. Same as 2C43	735717-37	94223
2C52	Not used.		
2C53	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v. Same as 2C10	735717-427	93602
2C54	Capacitor, fixed, mica, 1000 mmf ±10%, 500 v. Same as 2C3	984002-121	94189
2C55	Capacitor, fixed, ceramic, 1500 mmf +100 –0%, 500 v. Same as 2C2	449696-3	73748
2C56, 2C57	Not used.		
2C58	Capacitor, fixed, ceramic, 22 mmf ±10%, 500 v.	735717-21	59437
2C59, 2C60	Capacitor, fixed, mica, 1000 ±10%, 500 v. Same as 2C3	984002-121	94189
2C61	Capacitor, fixed, mica, 50 mmf ±10%, 500 v.	984002-161	94224
2C62	Capacitor, fixed, paper, 0.01 mf ±10%, 400 v.	735715-163	73561
2C63 to 2C65	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	102015
2C66	Capacitor, fixed, ceramic, 1500 mmf ±20%, 500 v. Same as 2C36	8864187-2	204866
2C67	Not used.		
2C68	Capacitor, fixed, paper, 0.0047 mf ±10%, 600 v.	735715-259	73920
2C69	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v.	735715-175	73551
2C70	Capacitor, fixed, ceramic, 150 mmf ±10%, 500 v.	735717-431	78276
2C71A, B, C	Capacitor, electrolytic, 10/10/10 mf, 400 v.	449618-1	56304
2C72	Capacitor, fixed, paper, 0.068 mf ±10%, 400 v.	735715-173	73792
2C73	Capacitor, fixed, ceramic, 680 mmf ±10%, 500 v.	735717-439	78305
2C74	Capacitor, fixed, ceramic, 1500 mmf ±10%, 500 v.	735717-443	75610
2C75	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v. Same as 2C69	735715-175	73551
2C76	Capacitor, fixed, ceramic, 470 mmf ±10%, 500 v. Same as 2C43	735717-37	94223
2C77	Capacitor, fixed, ceramic, 6.8 mmf ±1 mmf, 500 v.	90581-305	39043
2C78	Capacitor, fixed, ceramic, 820 mmf + 100 –0%, 500 v.	449696-1	94190
2C79	Capacitor, fixed, paper, 0.047 mf ±10%, 400 v.	735715-171	73553
2C80	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v. Same as 2C10	735717-427	93602
2C81	Capacitor, fixed, ceramic, 100 mmf ±10%, 500 v.	735717-29	93515
2C82	Capacitor, fixed, headed lead type, 0.68 mmf ±10%, 500 v.	99327-11	71504
2C83	Not used.		
2C84	Capacitor, fixed, ceramic, 1500 mmf +100 –0%, 500 v. Same as 2C2	449696-3	73748
2C85	Capacitor, fixed, ceramic, 820 mmf + 100 –0%, 500 v. Same as 2C78	449696-1	94190
2C86	Capacitor, fixed, ceramic, 1500 mmf ±20%, 500 v. Same as 2C36	8864187-2	204866
2C87	Capacitor, fixed, ceramic, 820 mmf + 100 –0%, 500 v. Same as 2C78	449696-1	94190
2C88	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	102015
2C89	Capacitor, fixed, ceramic, 820 mmf + 100 –0%, 500 v. Same as 2C78	449696-1	94190
2C90	Capacitor, fixed, headed lead type, 1.5 mmf ±10%, 500 v.	99327-13	71500
2C91	Capacitor, fixed, ceramic, 820 mmf + 100 –0%, 500 v. Same as 2C78	449696-1	94190
2C92	Capacitor, fixed, ceramic, 470 mmf ±10%, 500 v. Same as 2C43	735717-37	94223
2C93, 2C94	Capacitor, fixed, ceramic, 1500 mmf ±20%, 500 v. Same as 2C36	8864187-2	204866
2C95	Capacitor, fixed, ceramic, 10 mmf ±20%, 500 v.	8892567-4	94227
2C96	Not used.		
2C97	Capacitor, fixed, paper, 0.033 mf ±10%, 400 v.	735715-169	73552
2C98	Capacitor, fixed, ceramic, 12 mmf ±10%, 500 v.	735717-418	94228

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Symbol No.	Description	Drawing No.	Stock No.
2C99	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v. Same as 2C10	735717-427	93602
2C100	Capacitor, fixed, ceramic, 390 mmf ±10%, 500 v.	735717-436	75641
2C101 to 2C103	Capacitor, fixed, ceramic, 1500 mmf +100 -0%, 500 v. Same as 2C2	449696-3	73748
2C104	Capacitor, fixed, ceramic, 1500 mmf ±20%, 500 v. Same as 2C36	8864187-2	204866
2C105, 2C106	Capacitor, fixed, ceramic, 1500 mmf +100 -0%, 500 v. Same as 2C2	449696-3	73748
2C107	Capacitor, fixed, ceramic, 1500 mmf ±20%, 500 v. Same as 2C36	8864187-2	204866
2C108, 2C109	Capacitor, fixed, ceramic, 1500 mmf +100 -0%, 500 v. Same as 2C2	449696-3	73748
2C110	Capacitor, fixed, headed lead type, 1.0 mmf ±10%, 500 v.	99327-12	55331
2C111	Not used.		
2C112, 2C113	Capacitor, fixed, ceramic, 1500 mmf +100 -0%, 500 v. Same as 2C2	449696-3	73748
2C114	Capacitor, fixed, mica, 820 mmf ±5%, 500 v.	727868-245	39650
2C115, 2C116	Capacitor, fixed, ceramic, 10,000 mmf +100 -0%, 450 v.	449696-55	59997
2C117	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v. Same as 2C69	735715-175	73551
2C118	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	102015
2C119	Capacitor, fixed, ceramic, 10,000 mmf +100 -0%, 450 v. Same as 2C115	449696-55	59997
2C120	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v. Same as 2C69	735715-175	73551
2C121, 2C122	Capacitor, fixed, ceramic, 10,000 mmf +100 -0%, 450 v. Same as 2C115	449696-55	59997
2C123	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v. Same as 2C69	735715-175	73551
2C124	Capacitor, fixed, ceramic, 10,000 mmf +100 -0%, 450 v. Same as 2C115	449696-55	59997
2C125	Capacitor, fixed. paper, 0.047 mf ±10%, 200 v.	735715-71	73558
2C126	Capacitor, fixed, headed lead type, 4.7 mmf ±20%, 500 v.	99327-6	54402
2C127	Capacitor, fixed, paper, 0.047 mf ±10%, 400 v. Same as 2C79	735715-171	73553
2C128	Capacitor, fixed, ceramic, 680 mmf ±10%, 500 v. Same as 2C73	735717-439	78305
2C129	Capacitor, fixed, ceramic, 1500 mmf +100 -0%, 500 v. Same as 2C2	449696-3	73748
2C130	Capacitor, fixed, ceramic, 220 mmf +100 -0%, 500 v.	990167-9	77625
2C131	Capacitor, fixed, ceramic, 1500 mmf +100 -0%, 500 v. Same as 2C2	449696-3	73748
2C132, 2C133	Capacitor, fixed, ceramic, 1000 mmf +100 -20%, 500 v.	449696-2	77252
2C134	Capacitor, fixed, ceramic, 1500 mmf +100 -0%, 500 v. Same as 2C2	449696-3	73748
2C135, 2C136	Capacitor, fixed, ceramic, 1000 mmf +100 -20%, 500 v. Same as 2C132	449696-2	77252
2C137	Capacitor, fixed, ceramic, 1500 mmf +100 -0%, 500 v. Same as 2C2	449696-3	73748
2C138	Capacitor, fixed, ceramic, 1000 mmf +100 -20%, 500 v. Same as 2C132	449696-2	77252
2C139	Capacitor, fixed, mica, 1000 mmf ±10%, 500 v. Same as 2C3	984002-121	94189
2C140 to 2C143	Capacitor, fixed, ceramic, 1000 mmf ±20%, 500 v.	8825449-1	99177
2C144, 2C145	Capacitor, fixed, headed lead, 4.7 mmf ±20%, 500 v. Same as 2C50	99327-6	54402
2CR1	Rectifier, crystal diode IN21B	IN21B	67876
2CR2 to 2CR7	Rectifier, crystal diode CK705	CK705	94229
2J1	Connector, male, coaxial, chassis mtg., including 0.511 lg. probe	456961-501	95392
2J2	Coupling loop, comprising 1 female coaxial, chassis mtg. connector, sleeve, and 33 ohm ½ w resistor	8834436-501	94231
2J3 to 2J5	Connector, pin jack	742565-1	93678
2J6	Not used.		
2J7	Connector, pin jack. Same as 2J3	742565-1	93678
2J8, 2J9	Connector, female, coaxial, chassis mtg.	8845666-1	94205
2J10	Not used.		
2J11	Connector, male, 6 contact, chassis mtg.	181494-3	28507
2J12	Connector, female, 6 contact, chassis mtg.	181494-4	18534
2J13	Connector, male, 6 contact, chassis mtg. Same as 2J11	181494-3	28507
2J14, 2J15	Connector, pin jack. Same as 2J3	742565-1	93678
2K1	Relay, coil, 8000 ohm, contacts, s.p.d.t., plug-in type	8888583-1	56316
2K2	Relay, coil, 115 v. ac, 50/60 cy. contacts, d.p.d.t.	458952-1	95350
2K3	Relay, coil, 8000 ohm, contact, s.p.d.t. plug-in type. Same as 2K1	8888583-1	56316

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Symbol No.	Description	Drawing No.	Stock No.
2L1	Coil, adj. core, 18 turns	629132-511	94233
2L2	Coil, adj. core, 32 turns	629132-506	94234
2L3	Coil, adj. core, 22 turns	629132-509	94235
2L4	Reactors, r-f choke, 7.5 microhenry, 275 ma	459688-76	205050
2L5	Coil, adj. core, 33 turns	629132-505	94236
2L6	Coil, adj. core, 40 turns	629132-503	94237
2L7	Coil, adj. core, 19 turns	629132-510	94238
2L8	Reactor, r-f choke, 2.4 microhenry	8834424-501	94040
2L9	Not used.		
2L10	Coil, adj. core, 33 turns. Same as 2L5	629132-505	94236
2L11	Coil, adj. core, 40 turns. Same as 2L6	629132-503	94237
2L12	Coil, adj. core, 19 turns. Same as 2L7	629132-510	94238
2L13	Reactor, r-f choke, 2.4 microhenry. Same as 2L8	8834424-501	94040
2L14	Reactor, r-f choke, 7.5 microhenry, 275 ma. Same as 2L4	459688-76	205050
2L15	Coil, adj. core, 33 turns. Same as 2L5	629132-505	94236
2L16	Coil, adj. core, 40 turns. Same as 2L6	629132-503	94237
2L17	Coil, adj. core, 19 turns. Same as 2L7	629132-510	94238
2L18	Reactor, r-f choke, 2.4 microhenry. Same as 2L8	8834424-501	94040
2L19	Reactor, r-f choke, 7.5 microhenry, 275 ma. Same as 2L4	459688-76	205050
2L20	Coil, adj. core, 33 turns. Same as 2L5	629132-505	94236
2L21	Coil, adj. core, 40 turns. Same as 2L6	629132-503	94237
2L22	Coil, adj. core, 19 turns. Same as 2L7	629132-510	94238
2L23	Reactor, r-f choke, 2.4 microhenry. Same as 2L8	8834424-501	94040
2L24	Reactor, r-f choke, 7.5 microhenry, 275 ma. Same as 2L4	459688-76	205050
2L25	Coil, adj. core, 33 turns. Same as 2L5	629132-505	94236
2L26	Coil, adj. core, 40 turns. Same as 2L6	629132-503	94237
2L27	Coil, adj. core, 19 turns. Same as 2L7	629132-510	94238
2L28	Reactor, r-f choke, 2.4 microhenry. Same as 2L8	8834424-501	94040
2L29, 2L30	Reactor, r-f choke, 7.5 microhenry, 275 ma. Same as 2L4	459688-76	205050
2L31	Coil, adj. iron core, 15 turns	629132-526	94210
2L32	Reactor, r-f choke, 2.4 microhenry. Same as 2L8	8834424-501	94040
2L33, 2L34	Reactor, r-f choke, 7.5 microhenry, 275 ma. Same as 2L4	459688-76	205050
2L35	Coil, adj. iron core, 14 turns	629132-527	94239
2L36	Reactor, r-f choke, 2.4 microhenry. Same as 2L8	8834424-501	94040
2L37 to 2L39	Reactor, r-f choke, 7.5 microhenry, 275 ma. Same as 2L4	459688-76	205050
2L40	Coil, adj. iron core, 28 turns	629132-507	94240
2L41	Coil, adj. core, 22 turns. Same as 2L3	629132-509	94235
2L42	Coil, adj. iron core, 32 turns with conductive cloth covering	629132-528	96463
2L43	Reactor, r-f choke, 50 microhenry, 33 ma	8834437-502	94242
2L44	Reactor, r-f choke, 2.4 microhenry. Same as 2L8	8834424-501	94040
2L45, 2L46	Reactor, r-f choke, 7.5 microhenry, 275 ma. Same as 2L4	459688-76	205050
2L47	Coil, adj. iron core, 6 turns	629132-520	94211
2L48	Not used.		
2L49, 2L50	Coil, adj. iron core, 16 turns	629132-513	94241
2L51	Reactor, r-f choke, 7.5 microhenry, 275 ma. Same as 2L4	459688-76	205050
2L52	Coil, adj. iron core, 13 turns	629132-514	94244
2L53	Coil, adj. core, 22 turns. Same as 2L3	629132-509	94235
2L54	Coil, adj. iron core, 8 turns	629132-517	94245
2L55	Coil, adj. iron core, 10 turns	629132-516	94246
2L56	Coil, adj. iron core, 4 turns	629132-524	94208
2L57	Coil, adj. iron core, 11 turns	629132-535	205051

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Symbol No.	*Description*	*Drawing No.*	*Stock No.*
2L58	Coil, adj. iron core, 14 turns. Same as 2L35	629132-527	94239
2L59	Reactor, r-f choke, 2.4 microhenry. Same as 2L8	8834424-501	94040
2L60	Reactor, r-f choke, 7.5 microhenry, 275 ma. Same as 2L4	459688-76	205050
2L61	Reactor, r-f choke, 7 microhenry, 1000 ma	8834437-503	57259
2L62	Reactor, r-f inductor	8834423-502	95885
2L63	Reactor, r-f inductor	8834425-503	98387
	Core, tuning iron, threaded type, ¼-28 x 3⅛" lg., with fiber nut and spring washer (for above coils)	8832091-2	208637
2R1	Not used.		
2R2	Resistor, fixed, composition, 4700 ohm ±5%, ½ w.	82283-175	502247
2R3 to 2R5	Not used.		
2R6	Resistor, fixed, composition, 33 ohm ±10%, ½ w.	82283-44	502033
2R7	Not used.		
2R8	Resistor, fixed, composition, 4700 ohm ±5%, ½ w. Same as 2R2	82283-175	502247
2R9, 2R10	Not used.		
2R11	Resistor, fixed, composition, 68 ohm ±5%, ½ w.	82283-131	502068
2R12	Not used.		
2R13	Resistor, fixed, composition, 4700 ohm ±5%, ½ w. Same as 2R2	82283-175	502247
2R14, 2R15	Not used.		
2R16	Resistor, fixed, composition, 150 ohm ±10%, ½ w.	82283-52	502115
2R17	Not used.		
2R18	Resistor, fixed, composition, 4700 ohm ±5%, ½ w. Same as 2R2	82283-175	502247
2R19, 2R20	Not used.		
2R21	Resistor, fixed, composition, 27,000 ohm ±5%, ½ w.	82283-193	502327
2R22	Not used.		
2R23	Resistor, fixed, composition, 4700 ohm ±5%, ½ w. Same as 2R2	82283-175	502247
2R24	Not used.		
2R25	Resistor, fixed, composition, 470 ohm ±10%, ½ w.	82283-58	502147
2R26	Resistor, fixed, composition, 100 ohm ±10%, ½ w.	82283-50	502110
2R27	Resistor, fixed, composition, 1000 ohm ±10%, ½ w.	82283-62	502210
2R28	Not used.		
2R29, 2R30	Resistor, fixed, composition, 390 ohm ±10%, ½ w.	82283-57	502139
2R31	Resistor, fixed, composition, 3900 ohm ±5%, ½ w.	82283-173	502239
2R32	Resistor, fixed, composition, 12,000 ohm ±10%, 1 w.	90496-75	512312
2R33, 2R34	Resistor, fixed, composition, 390 ohm ±10%, ½ w. Same as 2R29	82283-57	502139
2R35	Resistor, fixed, composition, 3900 ohm ±5%, ½ w. Same as 2R31	82283-173	502239
2R36	Resistor, fixed, composition, 12000 ohm ±10%, 1 w. Same as 2R32	90496-75	512312
2R37	Resistor, fixed, composition, 2200 ohm ±5%, ½ w.	82283-167	502222
2R38, 2R39	Resistor, fixed, composition, 3300 ohm ±5%, ½ w.	82283-171	502233
2R40	Resistor, fixed, composition, 27,000 ohm ±5%, ½ w. Same as 2R21	82283-193	502327
2R41	Resistor, fixed, composition, 470,000 ohm ±10%, ½ w.	82283-94	502447
2R42	Resistor, fixed, wire wound, 22,000 ohm ±5%, 5 w.	458572-90	59175
2R43, 2R44	Resistor, fixed, composition, 1 megohm ±10%, ½ w.	82283-98	502510
2R45	Resistor, fixed, composition, 560,000 ohm ±10%, ½ w.	82283-95	502456
2R46	Resistor, variable, composition, 25,000 ohm ±10%, 2 w.	737829-31	94192
2R47	Resistor, fixed, composition, 2200 ohm ±10%, 1 w.	90496-66	512222
2R48	Resistor, fixed, composition, 1 megohm ±10%, ½ w. Same as 2R43	82283-98	502510
2R49	Resistor, fixed, composition, 120 ohm ±5%, ½ w.	82283-137	502112
2R50	Resistor, fixed, composition, 470 ohm ±5%, ½ w.	82283-151	502147
2R51	Not used.		
2R52	Resistor, fixed, composition, 100,000 ohm ±5%, ½ w.	82283-207	502410

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Symbol No.	*Description*	*Drawing No.*	*Stock No.*
2R53	Resistor, fixed, composition, 1000 ohm ±5%, ½ w.	82283-159	502210
2R54	Resistor, fixed, composition, 220,000 ohm ±5%, ½ w.	82283-215	502422
2R55	Resistor, fixed, composition, 470,000 ohm ±5%, ½ w.	82283-223	502447
2R56	Resistor, fixed, composition, 270,000 ohm ±5%, ½ w.	82283-217	502427
2R57	Resistor, fixed, composition, 150,000 ohm ±5%, ½ w.	82283-211	502415
2R58	Resistor, fixed, composition, 180,000 ohm ±5%, ½ w.	82283-213	502418
2R59	Resistor, fixed, composition, 390 ohm ±5%, ½ w.	82283-149	502139
2R60	Resistor, fixed, composition, 18,000 ohm ±10%, 2 w.	99126-77	522318
2R61	Resistor, fixed, composition, 10,000 ohm ±5%, ½ w.	82283-183	502310
2R62	Resistor, fixed, composition, 100,000 ohm ±5%, ½ w. Same as 2R52	82283-207	502410
2R63	Resistor, fixed, composition, 100,000 ohm ±5%, 1 w.	90496-207	512410
2R64	Not used.		
2R65	Resistor, fixed, composition, 47,000 ohm ±5%, 2 w.	99126-199	522347
2R66	Not used.		
2R67	Resistor, fixed, composition, 22,000 ohm ±5%, ½ w.	82283-191	502322
2R68	Resistor, fixed, composition, 1500 ohm ±5%, ½ w.	82283-163	502215
2R69	Resistor, fixed, composition, 120 ohm ±5%, ½ w. Same as 2R49	82283-137	502112
2R70	Resistor, fixed, composition, 1000 ohm ±5%, ½ w. Same as 2R53	82283-159	502210
2R71	Resistor, fixed, wire wound, 4800 ohm ±5%, 5 w.	458572-66	211398
2R72	Resistor, fixed, composition, 39,000 ohm ±10%, 2 w.	99126-81	522339
2R73	Resistor, fixed, composition, 4700 ohm ±5%, ½ w. Same as 2R2	82283-175	502247
2R74	Resistor, fixed, composition, 2700 ohm ±5%, ½ w.	82283-169	502227
2R75	Resistor, fixed, composition, 220 ohm ±5%, ½ w.	82283-143	502122
2R76	Resistor, fixed, composition, 22,000 ohm ±10%, 2 w.	99126-78	522322
2R77	Resistor, fixed, composition, 5600 ohm ±5%, ½ w.	82283-177	502256
2R78 to 2R81	Not used.		
2R82	Resistor, fixed, composition, 2700 ohm ±5%, ½ w. Same as 2R74	82283-169	502227
2R83	Resistor, fixed, composition, 100,000 ohm ±5%, ½ w. Same as 2R52	82283-207	502410
2R84	Not used.		
2R85	Resistor, fixed, composition, 27,000 ohm ±10%, 2 w.	99126-79	522327
2R86	Resistor, fixed, composition, 100,000 ohm ±10%, ½ w.	82283-86	502410
2R87	Resistor, fixed, composition, 10,000 ohm ±10%, 1 w.	90496-74	512310
2R88	Resistor, fixed, composition, 2200 ohm ±5%, ½ w. Same as 2R37	82283-167	502222
2R89	Resistor, fixed, composition, 150 ohm ±10%, ½ w. Same as 2R16	82283-52	502115
2R90	Resistor, fixed, composition, 10,000 ohm ±10%, 1 w. Same as 2R87	90496-74	512310
2R91	Resistor, fixed, composition, 2200 ohm ±5%, ½ w. Same as 2R37	82283-167	502222
2R92	Resistor, fixed, composition, 150 ohm ±10%, ½ w. Same as 2R16	82283-52	502115
2R93	Resistor, fixed, composition, 10,000 ohm ±10%, 1 w. Same as 2R87	90496-74	512310
2R94	Resistor, fixed, composition, 2200 ohm ±5%, ½ w. Same as 2R37	82283-167	502222
2R95	Resistor, fixed, composition, 150 ohm ±10%, ½ w. Same as 2R16	82283-52	502115
2R96	Resistor, fixed, composition, 10,000 ohm ±10%, 1 w. Same as 2R87	90496-74	512310
2R97	Resistor, fixed, composition, 2200 ohm ±5%, ½ w. Same as 2R37	82283-167	502222
2R98	Resistor, fixed, composition, 150 ohm ±10%, ½ w. Same as 2R16	82283-52	502115
2R99	Resistor, fixed, composition, 10,000 ohm ±10%, 1 w. Same as 2R87	90496-74	512310
2R100	Resistor, fixed, composition, 2200 ohm ±5%, ½ w. Same as 2R37	82283-167	502222
2R101	Resistor, fixed, composition, 10,000 ohm ±10%, 1 w. Same as 2R87	90496-74	512310
2R102	Resistor, fixed, composition, 100 ohm ±10%, ½ w. Same as 2R26	82283-50	502110
2R103, 2R104	Resistor, fixed, composition, 560 ohm ±10%, ½ w.	82283-59	502156
2R105, 2R106	Resistor, fixed, composition, 4700 ohm ±5%, ½ w. Same as 2R2	82283-175	502247
2R107	Resistor, variable, composition, 5000 ohm ±10%, 2 w.	737829-30	94039
2R108	Resistor, fixed, composition, 2200 ohm ±5%, ½ w. Same as 2R37	82283-167	502222

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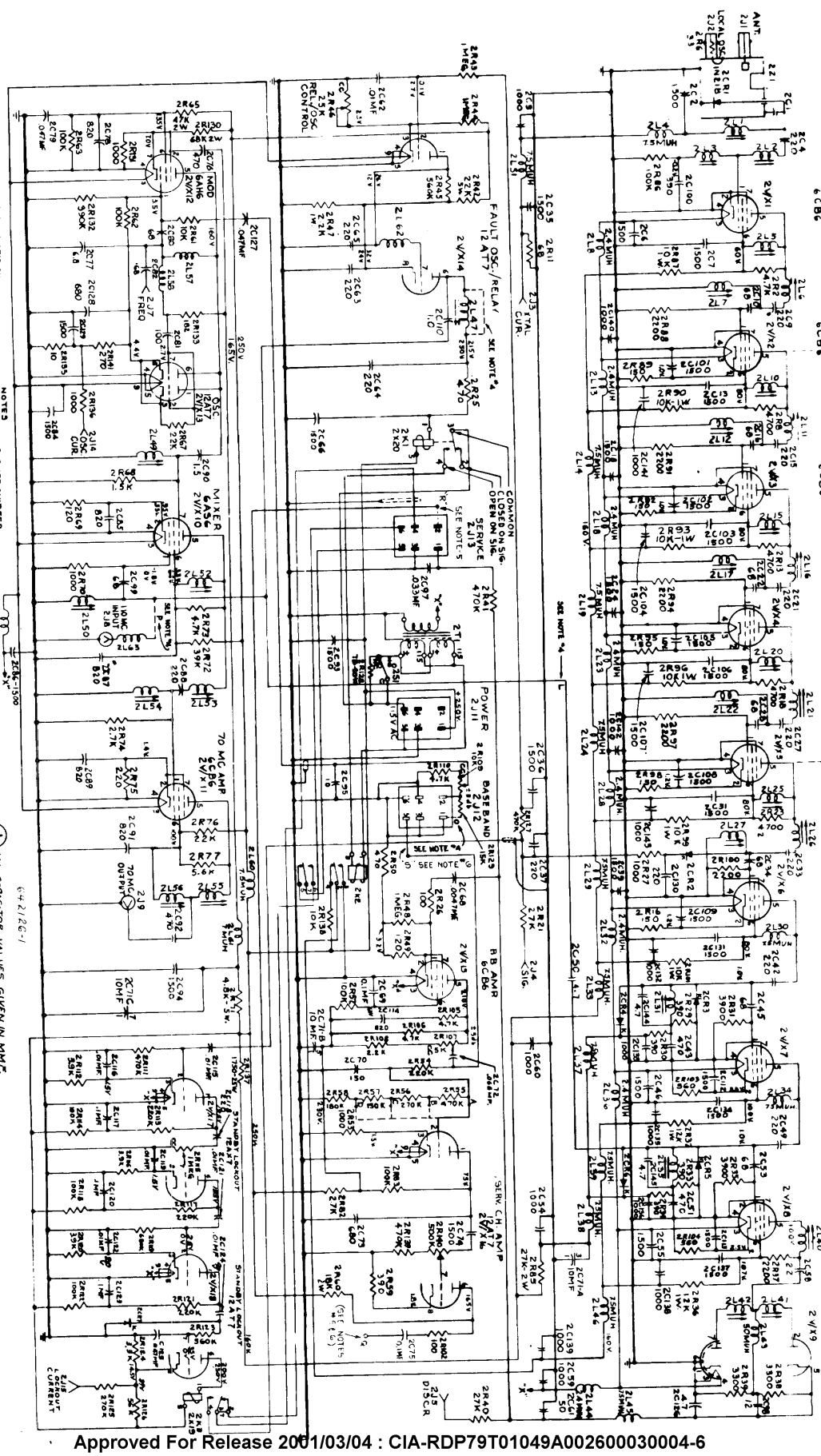
Symbol No.	*Description*	*Drawing No.*	*Stock No.*
2R109	Resistor, variable, composition, 10,000 ohm ±10%, 2 w.	737801-44	58983
2R110	Resistor, fixed, composition, 4700 ohm ±5%, ½ w. Same as 2R2	82283-175	502247
2R111	Resistor, fixed, composition, 470,000 ohm ±10%, ½ w. Same as 2R41	82283-94	502447
2R112	Resistor, fixed, composition, 3900 ohm ±5%, ½ w. Same as 2R31	82283-173	502239
2R113	Resistor, fixed, composition, 220,000 ohm ±5%, ½ w. Same as 2R54	82283-215	502422
2R114	Resistor, fixed, composition, 100,000 ohm ±10%, ½ w. Same as 2R86	82283-86	502410
2R115	Resistor, variable, 1 megohm ±20%, 2 w.	746053-22	98077
2R116	Resistor, fixed, composition, 3900 ohm ±5%, ½ w. Same as 2R31	82283-173	502239
2R117	Resistor, fixed, composition, 220,000 ohm ±5%, ½ w. Same as 2R54	82283-215	502422
2R118	Resistor, fixed, composition, 100,000 ohm ±10%, ½ w. Same as 2R86	82283-86	502410
2R119	Resistor, fixed, composition, 680,000 ohm ±10%, ½ w.	82283-96	502468
2R120	Resistor, fixed, composition, 3900 ohm ±5%, ½ w. Same as 2R31	82283-173	502239
2R121	Resistor, fixed, composition, 220,000 ohm ±5%, ½ w. Same as 2R54	82283-215	502422
2R122	Resistor, fixed, composition, 100,000 ohm ±10%, ½ w. Same as 2R86	82283-86	502410
2R123	Resistor, fixed, composition, 560,000 ohm ±10%, ½ w. Same as 2R45	82283-95	502456
2R124	Resistor, fixed, composition, 3300 ohm ±5%, ½ w. Same as 2R38	82283-171	502233
2R125	Resistor, fixed, composition, 270,000 ohm ±5%, ½ w. Same as 2R56	82283-217	502427
2R126	Resistor, fixed, wire wound, 56,000 ohm ±5%, 10 w.	458574-90	53702
2R127	Resistor, fixed, composition, 470,000 ohm ±10%, ½ w. Same as 2R41	82283-94	502447
2R128	Resistor, fixed, wire wound, 75 ohm ±10%, 20 w.	8811127-1	16239
2R129	Resistor, fixed, composition, 15,000 ohm ±5%, ½ w.	82283-187	502315
2R130	Resistor, fixed, composition, 68,000 ohm ±5%, 2 w.	99126-203	522368
2R131	Resistor, fixed, carbon film type, 1000 ohm ±1%, ½ w.	990185-301	207762
2R132	Resistor, fixed, composition, 390,000 ohm ±5%, ½ w.	82283-221	502439
2R133	Resistor, fixed, carbon film type, 182 ohm ±1%, ½ w.	990185-226	207833
2R134	Not used.		
2R135	Resistor, fixed, composition, 10 ohm ±5%, ½ w.	82283-111	502010
2R136	Resistor, fixed, composition, 1000 ohm ±5%, ½ w. Same as 2R53	82283-159	502210
2R137	Resistor, fixed, wire wound, 1750 ohm ±10%, 25 w.	8817665-21	206726
2R138	Resistor, fixed, composition, 10,000 ohm ±10%, 2 w.	99126-74	522310
2R139	Resistor, fixed, composition, 470,000 ohm ±10%, ½ w. Same as 2R41	82283-94	502447
2R140	Resistor, variable, composition, 500,000 ohm ±20%, 2 w.	737887-12	206494
2R141	Resistor, fixed, composition, 270 ohm ±5%, ½ w.	735730-145	502127
2S1	Switch, push type, s.p.d.t., with black button	8835332-2	95572
2T1	Transformer, filament	8874796-1	57650
2X1 to 2X12	Socket, tube, 7 pin miniature	737867-18	94879
2X13, 2X14	Socket, tube, 9 pin miniature	984055-2	94880
2X15	Socket, tube, 7 pin miniature. Same as 2X1	737867-18	94879
2X16 to 2X18	Socket, tube, 9 pin miniature. Same as 2X13	984055-2	94880
2X19, 2X20	Socket, tube, 5 pin	849224-1	43639
2X21	Socket, tube, octal, red bakelite	746008-34	94879
2Z1	Cavity assembly, not stocked complete—associated parts below	458907-502	
	Contact, beryllium copper, for 2Z1	8834416-1	94390
	Core, brass tuning, ⅝-24 thread, 1 1/16" lg., 2Z1 tuning	8831031-1	95393
	Insulator, teflon, coated glass fabric, 1 3/16" x 1 3/16" x 0.010" thick (4 req'd) (for 2Z1)	8834415-1	94389
	Nut, hex, brass #⅝-24 thread tuning core locking (for 2Z1)	874927-6	95395
	Washer, spring ⅞" O.D. x 21/32" I.D. x 0.25" thick, beryllium copper, tuning core tension (for 2Z1)	8831068-2	95394

Symbol No.	Description	Drawing No.	Stock No.
	Miscellaneous		
	Connector, male, coaxial, cable mtg.	8898625-501	54392
	Screw, thumb, #10-32, 1" lg. back cover holding	8886111-2	94391
	Shield, tube, 7 pin miniature, 1¾" lg.	99369-2	54521
	Shield, tube, 7 pin miniature, 1⅜" lg.	99369-1	53016
	Shield, tube, 9 pin miniature, 1 15/16" lg.	8858642-3	56359
	Terminal, stand off melamine body, 27/32" lg., with #4-40 tapped mtg. hole	8886187-1	211646

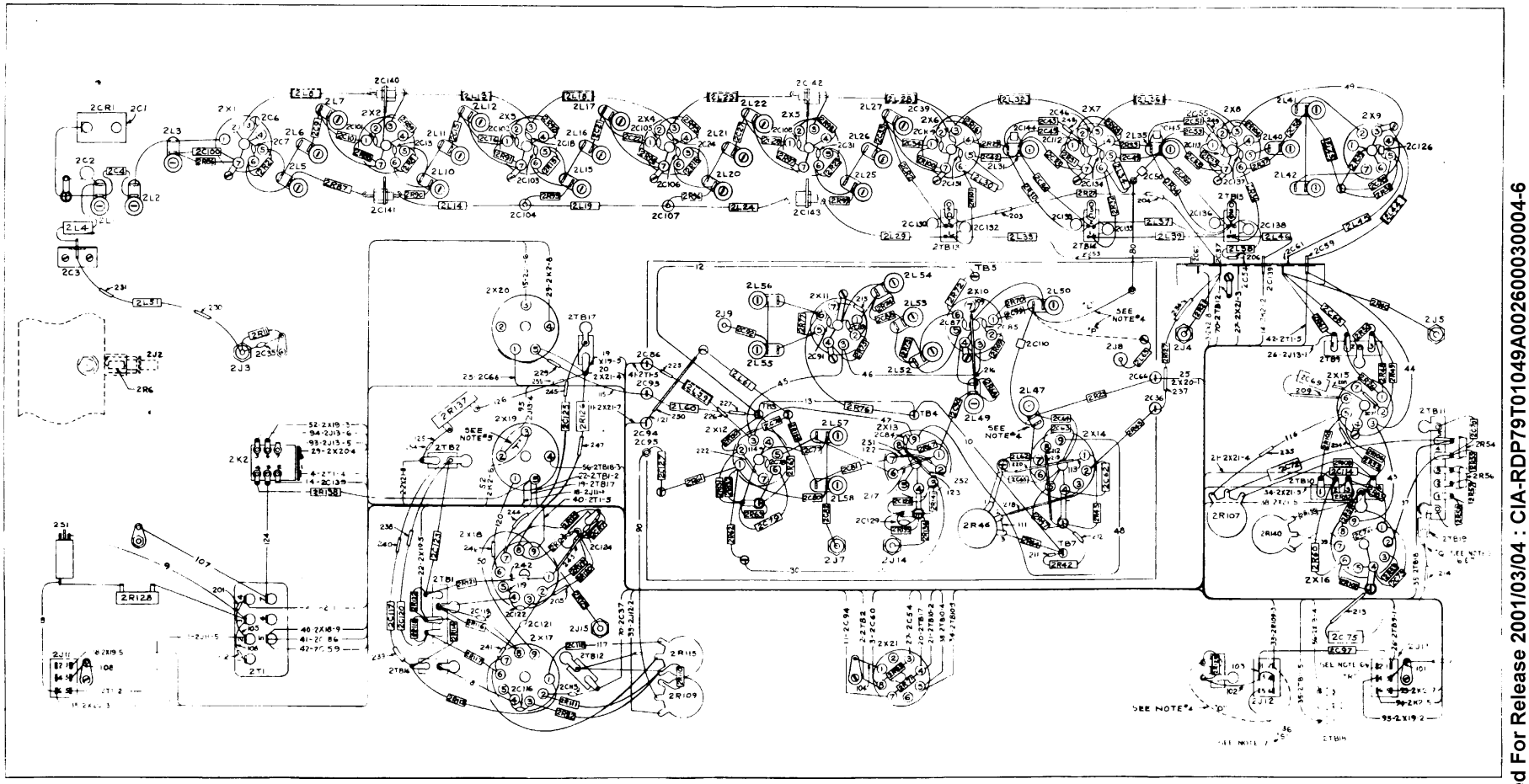


NOTES

1. TUBES 2V1T12 AND 2V1T13 ARE OMITTED WHEN EQUIPMENT IS OPERATED WITHOUT STANDBY EQUIPMENT.
2. CONNECTION 2J8 (MOD INPUT) IS OMITTED WHEN EQUIPMENT IS OPERATED WITH STANDBY EQUIPMENT.
3. LEGEND OF BRACKETS IS FOR MICROPHONE SIGNAL EXCEPT IN 2V8 UPPER VALUE 150Ω LITTLE OR NO SIGNAL - LOWER VALUE IS FOR 8V1 PULLED.
4. ADD LEAD "D" AT 2C59 & SHORT 2L47 WHEN RECEIVER IS USE IN TERMINAL STATION.
5. CONNECT "Q" TO 2J13-2 AND OMIT "R" FOR STATION USING REPEATER OR TERMINAL DROP REPTR STATIONS USING INDICON SERV. CHAN SYSTEM. LEAVE "Q" FLTG AT TERM. STATION.
6. DISCONNECT "S" & TIE "N" TO 2J13-5 AT THRU REPTR STATIONS USING INDICON SERVICE CHANNEL SYSTEM, AND ADD LEAD "R" AT 2J13-2.

(1) ALL CAPACITOR VALUES GIVEN IN MMF AND ALL RESISTOR VALUES GIVEN IN OHMS UNLESS OTHERWISE SPECIFIED.

Figure RM-11—Receiver/Modulator—Schematic Diagram



WIRE TABLE			A-8926364-501		
WIRE NOS (INCLUSIVE)	DESCRIPTION COLOR AND CONDUCTOR		PS NO. OR DRAWING NO.	PTS LIST ITEM NO.	WIRE NOS. NOT USED
1 TO 4	WHT-BLUE	7 X.010	PS 805-6	89	
8 TO 11	WHITE			90	
18 TO 22	WHT-RED			91	
25 TO 30	WHT-YEL			92	28
33 TO 39	WHT-GRN	7 X.010	PS 805-6	93	
40 TO 50	WHT-BRN/GRN	7 X.010	PS 805-6	94	
52	WHT-ORN/BLK	7 X .010	PS 805-6	76	
56	WHT-BLK	7 X .010	PS 805-6	78	
70	WHITE	SHIELDED WIRE	8845679-1	86	
80	BUS WIRE	(INSULATED)	8836025-1	96	
90	RF CABLE	RG 58/U	PS 145-58	87	
93	WHITE	SCONDUCTOR SHIELDED CABLE	460202-502	98	
94	WHT-BLUE				
95	WHT-YEL				
101 TO 104	TINNED COPPER WIRE	.032 DIA	PS 103	83	
105 TO 107	TINNED COPPER WIRE	.050 DIA.	PS 105	79	
108 TO 126	TINNED COPPER WIRE	.032 DIA	PS 103	83	110
201 TO 234	BLK INS TUBING	.031 ID	PS 8	82	

NOTES:-

1- DESIGNATION IN WIRES ARE WIRE NUMBERS AND THEIR DESTINATIONS.

2- SOLDER ALL ELECTRICAL CONNECTIONS USING ITEM 86. ALL WIRING TO BE IN ACCORDANCE WITH RCA STANDARD PRACTICE.

3- CABLE AND THEN LACE WIRES, WHERE NECESSARY USING LACING CORD, ITEM 80.

4- WHEN RECEIVER IS USED IN TERMINAL STATION ADD 'D' & 'P' LEADS, DISCONNECT LEAD 'L' AT 2C99 & SHORT 2L47.

5- CONNECTION 'T' (2X19-2 TO 2X19-3) IS OMITTED WHEN RECEIVER IS USED IN A SYSTEM WITH STANDBY EQUIPMENT, AND/OR INDICON SERVICE CHANNEL SYSTEM.

6- CONNECT 'G' TO 2J15-2 AND OMIT LEAD 'R' FOR STATIONS USING RPTR SERVICE UNIT MI 31495 OR TERM SERVICE UNIT MI 31496. ADD LEAD 'R' AND LEAVE 'G' UNCONNECTED AT TERMINAL AND DROP RPTR STATIONS USING INDICON SERVICE CHANNEL SYSTEM.

7- DISCONNECT LEADS 'S' AND CONNECT 'G' TO 2J12-5 AT THRU REPEATER STATIONS USING INDICON SERVICE CHANNEL SYSTEM, AND ALL TERMINAL STATIONS.

Figure RM-12—Receiver/Modulator—Wiring Diagram

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MICROWAVE COMMUNICATION EQUIPMENT

Receiver / Modulator MI-31102-A

- TECHNICAL DATA
- DESCRIPTION
- MAINTENANCE
- REPLACEMENT PARTS

RADIO CORPORATION OF AMERICA
ENGINEERING PRODUCTS DIVISION, CAMDEN, N. J.

PRINTED IN U. S. A.
5104

IB-33227

Approved For Release 2001/03/04 : CIA-RDP79T01049A002600030004-6

TECHNICAL DATA

Power Input:
a. Filament Heaters: 35 watts at 115 v, 50/60 cycle ac
b. Plate Supply: 130 milliamps at 250 v dc

Frequency Range
2450-2700 megacycles

Receiver Band Width
6 megacycles

Receiver Noise Figure
12 db

I.F. Frequency
30 mc

R.F. Input Impedance
50 ohms

Carrier Operated Relay Sensitivity
C/N = 12 db max.

Baseband Output for ±1.5 mc Peak Deviation
1.2 v rms ±3.0 db

Baseband Output Frequency Range
3 kc to 135 kc

Service Channel Output for ±75 kc Peak Deviation
10 v rms, + 5 db, −3 db

Service Channel Frequency Response
300 cps to 3 kc ±2 db

Service Channel Signal-to-Noise Ratio
(below ±75 kc peak deviation)
35 db

Modulator Input for ±1.5 mc Peak Deviation
0.85 v

Relays

Symbol	*Function*
2K1	Receiver Fault
2K2	Noise Suppression
2K3	Standby Lockout

Crystals

Symbol	*Type*	*Function*
2CR1	1N21B	RF Mixer
2CR2	CK705	RF Rectifier
2CR3	CK705	First Limiter
2CR4	CK705	First Limiter
2CR5	CK705	Second Limiter
2CR6	CK705	Second Limiter
2CR7	CK705	RF Rectifier

Tube Complement

Symbol	*Type*	*Function*
2V1	6CB6	First i-f Amplifier
2V2	6CB6	Second i-f Amplifier
2V3	6CB6	Third i-f Amplifier
2V4	6CB6	Fourth i-f Amplifier
2V5	6CB6	Fifth i-f Amplifier
2V6	6CB6	Sixth i-f Amplifier
2V7	6CB6	First Limiter
2V8	6CB8	Second Limiter
2V9	6AL5	Discriminator
2V10	6AS6	Modulator Mixer
2V11	6CB6	70 MC Amplifier
2V12	6AH6	FM Modulator
2V13	12AT7	40 MC Oscillator
2V14	12AT7	Fault Oscillator
2V15	6CB6	Baseband Amplifier
2V16	12AT7	Service Channel Amplifier
2V17	12AX7	Lockout Amplifier
2V18	12AT7	Lockout Amplifier

Weight and Dimensions
Weight—15 lbs.
Height—8¾"
Depth back of panel: 2⅞"
Depth front of panel: 4"
Width: 19" Rack Mounting

DESCRIPTION

The MI-31102-A Receiver/Modulator is designed for mounting in either a standard 19" open rack or cabinet and is used in both terminal and repeater stations. The unit has two main functions. The receiver section amplifies and demodulates the incoming f-m signal from a terminal or repeater station and delivers the .3 to 135 kc information to the baseband and/or service units. The modulator section provides the transmitter with a 70 mc f-m carrier, modulated with the .3 to 135 kc multiplex and service channel signals. In a receiver at a repeater station the modulation on this 70 mc carrier also includes the incoming modulation on the 30 mc i-f signal.

Receiver/Modulator MI-31102-A combines the dual function of receiving, amplifying, and demodulating the incoming r-f signal and of supplying an intelligence bearing 70 mc carrier to the transmitter unit which is used in producing the outgoing microwave carrier.

Receiver

In the receiving section the incoming microwave signal is first converted to a 30 mc i-f. This is accomplished by mixing the microwave signal with a sample of the transmitter local oscillator frequency. These two frequencies are always 30 mc

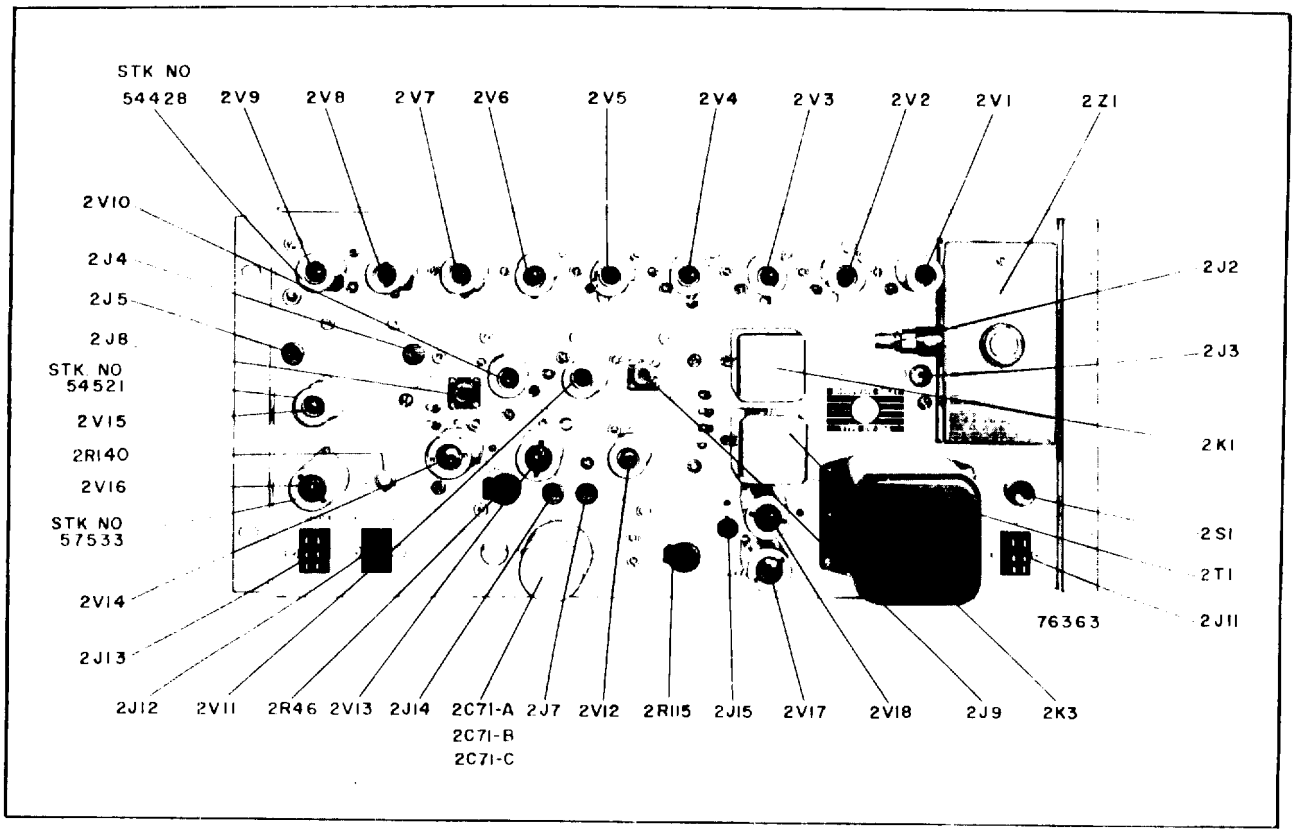


Figure RM-1—Receiver/Modulator, MI-31102-A—Front View

apart in accordance with the system plan. Refer to the system instructions for Typical Systems Frequencies. This mixing is done in mixer cavity 2Z1 which receives the microwave signal through a coaxial cable from the receiving filter unit MI-31113-A. This cable is connected to cavity terminal 2J1 on the back of the chassis. A sample of the transmitter local oscillator frequency is fed by means of a coaxial cable from terminal 1J1 of the transmitter to terminal 2J2, labeled LOCAL OSC., of the mixer cavity 2Z1. The difference frequency is generated by the mixer cavity crystal 1N21B and delivered to the grid of the first 30 mc i-f stage. The screwdriver adjusting control on the front of 2Z1 resonates the cavity to the correct frequency. Coupling loop 2J2 couples the local oscillator energy into the mixer cavity. The 30 mc output of cavity 2Z1 is amplified by 6 stages (2V1 thru 2V6) of i-f amplifiers to a sufficiently high level so that proper limiting action can take place in the two limiting stages 2V7 and 2V8. Each of the two limiting stages contain dual limiting circuits. Besides the limiting that occurs in the electron tubes, additional limiting action is performed in the circuits containing crystals 2CR3 and 2CR4 of the 1st limiter stage and crystals 2CR5 and 2CR6 of the 2nd limiter stage. The 30 mc output of the 2nd limiter stage is fed to discriminator 2V9 where the f-m signal is demodulated and the 300 cycle to 135 kc component delivered to baseband amplifier 2V15. The output of 2V15 is connected to plug 2J12 for delivery to the baseband unit. Service channel amplifier 2V16 taps off a portion of the 300 cycle to 3 kc band for amplification before reaching plug 2J13 outlet to the service unit. A connection to terminal 1 of jack 2J13 from the discriminator output provides the dc amplifier of the transmitter AFC circuit with the dc correction voltage when the transmitter local oscillator drifts off frequency.

Modulator

In the modulator section, mixer 2V10 produces the 70 mc i-f signal which modulates the transmitter microwave carrier. Amplifier 2V11 amplifies the 70 mc i-f output of the modulator i-f mixer which is then coupled by coaxial cable to the transmitter by means of 70 MC OUTPUT jack 2J9. The source of the two signals that supply modulator i-f mixer 2V10 with its heterodyning frequencies differ for each type of station as follows:

a. At a terminal station the 70 mc subcarrier output of the modulator i-f mixer 2V10 is the difference frequency of a 110 mc and a 40 mc signal. The 40 mc signal is the output of oscillator 2V13 and contains the multiplex and service channel signals from the baseband unit. The 110 mc frequency is received from the terminal AFC and is coupled through a coaxial cable to the 110 MC INPUT jack 2J8 of the receiver/modulator. At terminal stations only, internal bus connection "P" must be made to jack 2J8, connection "O" made at jack 2J12, coil 2L47 shorted, and connection "L" omitted. (The letters "P", "O" and "L" refer to connections found on the receiver/modulator schematic of figure RM-8.) Adding connection "P" feeds the 110 mc frequency from the terminal AFC unit to the modulator i-f mixer 2V10. Removing connection "L" disconnects the receiver 30 mc signal from 2V10. Shorting 2L47 prevents 2V14 from operating as a 110 mc oscillator. Adding connection "O" maintains the proper baseband output load impedance when only one receiver/modulator unit is used as at a terminal station. The amount of baseband signal applied to 2V12 is determined by the setting of MODULATOR GAIN control 2R109 which is adjusted at the factory so that the modulation sensitivity of all receiver/modulator units will be the same.

b. At drop repeater stations the 70 mc subcarrier output of the modulator i-f mixer 2V10 is the sum frequency of a 30 mc and a 40 mc signal. The signal from the 40 mc oscillator 2V13 and frequency modulator 2V12 contains the 300 cycle to 135 kc multiplex and service channel frequencies added at this station. The 30 mc signal comes from the receiver 1st limiter stage output and contains the intelligence modulated on the received microwave signal.

c. The modulator section of a thru repeater station is the same as that of a drop repeater station except the 40 mc oscillator signal to the modulator-mixer stage 2V10 contain only 300 cycles to 3 kc service channel information (voice communication and fault tone pulses) from the repeater service unit MI-31495-A.

In repeater stations the 30 mc frequency to the modulator mixer stage 2V10 comes from the 1st limiter (2V7) output circuit. Be certain that internal connection L is made when the receiver/-modulator is used in either a drop repeater or a thru repeater station and removed when used at a terminal station.

Fault Circuit

The fault circuit consists of fault oscillator 2V14 and relays 2K1 and 2K2. This circuit performs its functions when the i-f amplifier fails or when the microwave signal from the previous transmitter is absent. When either of the above conditions exists a lowering of the normal positive dc voltage from crystal 2CR2 of the sixth receiver i-f stage to the control grid #2 of fault oscillator 2V14 causes the following action to occur:

a. At a drop or thru repeater station the 110 mc fault oscillator 2V14 normally is inoperative, but when the receiver signal fails the blocking bias is removed and 2V14 starts oscillating to supply one of the heterodyne frequencies to mixer 2V10. This frequency in combination with the 40 mc oscillator output (110 mc – 40 mc) provides the necessary 70 mc output to keep the transmitter radiating a quieted microwave carrier. In addition relay 2K1 is operated.

b. At a terminal station the 110 mc output of fault oscillator 2V14 is not required, so 2V14 is changed to a dc amplifier by shorting out plate coil 2L47. If the incoming signal stops or the i-f amplifier fails, amplifier 2V14 will cause 2K1 to operate.

Relay 2K1 Operation

1. Contact 2-3 opens. This breaks the 115 v ac supply to the AFC motor in the transmitter, disabling it for the duration of the fault. This is done because, if the absence of an incoming signal is the reason 2K1 is energized, amplified noise from the i-f amplifier may produce a dc voltage at the discriminator output which would cause the AFC motor to run although no transmitter frequency correction is necessary.

2. Contact 3-4 closes, operating relay 2K2.

Relay 2K2 Operation

1. Contact 2-4 opens. This breaks the B+ circuit to limiters 2V7 and 2V8, keeping noise from being fed to the discriminator 2V9 and mixer 2V10 at a repeater station or to 2V9 only at a terminal station. The noise voltage is thus prevented from reaching the multiplex equipment and service units and from being transmitted.

2. Contact 6-7 closes.

(a) At a non-standby station contact 6-7 connects the 115 v ac to the receiver fault relay in the service unit (Relay 6K3 of the repeater service unit at a repeater station or relay 7K5 of the terminal service unit at a terminal station) through the shorted 2-3 contact of relay 2K3 of the standby lock-

out circuit. At a non-standby station contact 2-3 of 2K3 is shorted by connection "T" as shown in figure RM-8. Relays 6K3 and 7K5 start the fault reporting operation.

(b) At a standby station, contact 6-7 connects the 115 v ac to the receiver fault relay of the service unit (Relay 6K3 of the repeater service unit at a repeater station or relay 7K5 of the terminal service unit at a terminal station) and starts the fault reporting operation *provided contact 2-3 of 2K3 is closed.* This also connects the 115 v ac to the receiver fault switchover relay of the standby switching unit (Relay 9K8 of the repeater switching unit at a repeater station or relay 10K7 of the terminal switching unit at a terminal station) and initiates the radio equipment standby switchover operation. If the receiver i-f amplifier fails, contact 2-3 of 2K3 is closed (2K3 released) by the action of the standby lockout circuit and standby switchover occurs and a fault signal is transmitted. Failure of the incoming signal will not cause the standby lockout circuit to operate 2K3, opening contact 2-3; therefore standby switchover and fault signal transmission will be avoided.

Standby Lockout Circuit

At a standby equipped station, some method must be provided so that the standby radio equipment will not be switched into operation due to a cessation of the incoming microwave signal but will occur only when the receiver i-f amplifier actually fails to function. The standby lockout circuit of the receiver/modulator unit provides this facility at all installations. This circuit consists of amplifier stages 2V17, 2V18 and relay 2K3. For a complete description of the functioning of the standby lockout circuit, consult the CW-20A (MM-20A) Standby Switchover Instructions, IB-24978.

Tube Check

When the TUBE CHECK pushbutton 2S1 is pressed a 75 ohm resistor is connected in series with the primary of filament transformer 2T1. This reduces the filament voltage of the tubes by approximately 25%. By checking the meter reading at the various circuit test points and by other test checks the marginal tubes will be revealed.

CONTROLS

a. The Cavity Tuning control (2Z1) is used to tune the mixer cavity to the frequency of the incoming signal from the antenna.

b. The REL. OSC. control (2R46) adjusts the grid bias of the dc amplifier section of 2V14 for proper action of relay 2K1.

c. The DISC pin jack (2J5) is used to connect test meter 1M1 to the output of the discriminator to determine if the i-f frequency is centered at 30 mc.

d. The SIG. pin jack (2J4) is used to connect the test meter 1M1 to measure the signal voltage of the i-f section when tuning the receiver.

e. The CUR. (2J14) pin jack is used to connect the test meter 1M1 when tuning the 40 mc f-m osc. of the modulator section.

f. The FREQ. (2J7) pin jack is used to connect the distortion and modulation test unit to the modulator while aligning the receiver.

g. The XTAL. CUR pin jack (2J3) is used to connect the test meter 1M1 when adjusting 2J2 of the mixer cavity for proper crystal excitation.

h. The 110 MC INPUT (2J8) coaxial terminal is used to connect the 110 mc output of the terminal AFC unit to the receiver r-f mixer grid. It is used only at terminal stations.

i. The 70 MC OUTPUT coaxial terminal (2J9) is used to connect the 70 mc output of the modulator section to the transmitter 70 mc input.

j. The LOCAL OSC coaxial terminal (2J2) is the input terminal for connecting a portion of the output of the transmitter local oscillator to the mixer cavity.

h. The Receiver Baseband Gain control 2R107 is a screw driver adjusting potentiometer for regulating the signal voltage level from amplifier stage 2V15 to the baseband unit and to the signal channel amplifier stage 2V16. This control, located in the rear of the unit, is adjusted and sealed at the factory and normally requires no adjustment in the field.

l. The Modulator Gain control 2R109 is a screwdriver adjusting potentiometer for controlling the amount of signal voltage from the baseband unit applied to the 40 mc modulator stage 2V12. This control, located in the rear of the unit, is adjusted and sealed at the factory and normally requires no adjustment in the field.

m. The NOISE GAIN potentiometer 2R115 is a control for regulating the amount of noise signal to amplifier 2V17 (6-7-8).

n. The "OPR CUR" jack 2J15 is for monitoring the operating current of the dc amplifier 2V18 (6-7-8) when adjusting the noise gain control.

o. The TUBE CHECK pushbutton 2S1 is used to reduce the filament voltage of the tubes for the purpose of checking their operating condition.

p. The SERV CHAN GAIN control 2R140 is used to adjust the gain of the service channel amplifier 2V16.

MAINTENANCE

General Notes

To check the gain of the 30 mc i-f amplifier section remove the receiver antenna and check the noise reading at the SIG jack 2J4. This reading should be 5 μa or more. If less than 5 μa replace the low emission tubes of the 30 mc i-f section 2V1 through 2V5.

Regarding changing tubes in the receiver/modulator it should be cautioned that certain tubes should be replaced only if absolutely necessary. 2V8 (2nd Lim.), 2V9 (Discr.), 2V12 (Mod.), and 2V13 (Osc.) have effects upon the modulation and demodulation linearity of the system. As a consequence these should not be changed unless complete tube failure makes it necessary.

The changing of these tubes may affect the linearity of these stages. Do not attempt a linearity realignment unless the cross talk between channels is noticed to increase intolerably. See the CIRCUIT ALIGNMENT section following, if linearity alignment is required.

If either 2V12 or 2V13 are changed, the frequency of the 2V13 oscillator should be adjusted to 40 mc by varying 2L57 "40 MC OSC" only. When measuring the frequency of the 40 mc oscillator there must be no modulation on it. To make sure there is no minimum hum input it is wise to pull out the baseband plug feeding the receiver/modulator during the measurement. If 2V14 is changed the frequency and operating point of the 110 mc oscillator will need to be reset.

The information required for checking and adjusting the frequency of the 40 mc and 110 mc oscillators will be found in the INITIAL ADJUSTMENT procedure of the system instructions and the CIRCUIT ALIGNMENT section following.

When *replacing a 1N21B Crystal,* caution must be exercised to prevent damaging the crystal by static discharge. To prevent this, one hand should be grounded to the chassis before the crystal is allowed to touch any part of the equipment. A soldering iron should never be used on circuits connected to the 1N21B crystal without unplugging the iron for the period of use. AC leakage current may otherwise burn out the crystal. The 1N21B crystal current should never be allowed to exceed a meter reading at 2J3 of 200 μa.

If a tuning coil in the 30 mc i-f or 70 mc i-f circuits should open or become damaged, install a replacement coil with its core turned in the same amount as in the faulty coil. When thus repaired these circuits will be adequately well aligned.

Tuning coils of the frequency modulator stages 2V12 or 2V13 and discriminator stage 2V9 cannot be replaced without alignment of those circuits.

The plug-in electrolytic capacitor 2C71 should be replaced after being in use continuously for one year.

The schematic of figure RM-8 shows the dc voltage values at all pertinent circuit check points. Certain of these points contain double voltage readings. Wherever these readings occur, except for standby lockout circuit 2V18, the value above the line is the voltage with no signal at the receiver input and the value below the line is present with a saturating signal. For 2V18 the upper value is for little or no signal and the lower value is with tube 2V1 removed.

CIRCUIT ALIGNMENT

The following instructions describe the process for complete realignment of a receiver/modulator unit. It is strongly cautioned that before such a realignment be attempted full familiarity with the unit be obtained and all of the recommended test equipment listed in the test equipment tables of the system instructions be assembled.

The test items specified in the following alignment procedures refer to the test equipment items listed in the test equipment tables of the system instructions.

Limiter Alignment

a. Attach the sweep generator output to the junction of 2C42 and 2C45; attach the scope lead to the junction of 2L40 and 2R37; attach test equipment item 27(a) between ground and 2C60. Set the sweep generator output low enough so that the stage has not started to limit and the scope response is sharp. Peak 2L35 at 30.0 mc.

NOTE: In this and other applications, use a 10 microhenry r-f choke with leads approximately one inch long (test item 27(d)) in series with the scope lead.

b. Repeat the above, peaking 2L31 with the sweep generator attached to the high side of 2L27 and the scope attached to 2V7-6. Remove test equipment item 27(a).

30 MC IF Alignment

a. Remove the rubber base cement used to prevent the cores of the i-f transformers from moving. Use a sharp instrument to loosen the edge of the seal and then peel off the cement. Screw all cores in so their tops are approximately flush with the top of the locking washer.

b. Apply the output of the 30 mc sweep generator to the bottom end of 2L22, ground pin 1 of 2V4 to the center pin of the socket with a test prod, and attach the scope to the junction of 2C37 and 2R21. Adjust the output of the sweep generator for approximately +0.2 v dc at 2R21 with the "sweep" knob in the "narrow" position. Turn on the sweep generator markers at 25.6 mc and 34.4 mc. With the "sweep" knob in the "wide" position, align the stage for symmetrical response, (stages will vary from critical coupled to somewhat less than critical coupled) and for band-width such that the two markers fall on the 50% response point. It will be found that 2L25 and 2L27 act much the same as the primary and secondary respectively of a double-tuned circuit. 2L26 controls the primary-to-secondary coupling and consequently the stage bandwidth.

NOTE: Solder a 100 K ohm isolation resistor in series with the Voltohmyst test probe.

c. Connect the sweep generator to 2L17, ground 2V3-1, connect alignment jig (test equipment item 27(c)) to the bottom end of 2C27, and attach the scope to the alignment jig. With the scope gain on maximum, adjust the sweep generator output for the minimum value providing an adequate picture. Align 2L20, 21 and 22 as above except place the 25.6 mc marker at the 60% response point and the 34.4 mc marker at the 40% response point as shown in figure RM-2.

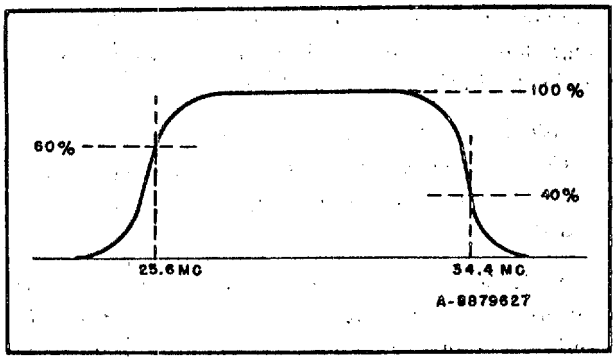


Figure RM-2—30 mc IF Response Curve

This is done so that when the slight capacity added by the alignment jig is removed, the stage will be properly centered around 30 mc.

d. Apply the sweep generator to 2L12, ground 2V2-1, attach the alignment jig to the bottom of 2C21, and apply capacitor test equipment item 27(e), to 2V5-5 so as to ground this point to r-f only. Align 2L15, 16 and 17 as in (c).

e. Align 2L10, 11 and 12 as in (d) by moving all test equipment items forward one stage.

f. Attach the 680-ohm - 47 ohm resistor combination, test equipment item 27(b), between the screw directly above 2L3 and the standoff insulator connecting to 2L1.

Align 2L5, 6 and 7 as in (d) by moving all test equipment items forward one stage except apply sweep generator through a 1500 mmf ceramic capacitor to 2V1-1.

g. Attach the sweep generator to the high side of the 47 ohm resistor, the scope to the junction of 2L3 and 2R86 and r-f ground 2V2-5. Align 2L1, 2 and 3 for a flat-topped response regardless of the stage bandwidth unless this bandwidth is less than 8.8 mc. In this latter case align for 8.8 mc bandwidth.

Since the alignment jig is not used in this case the stage is to be aligned symmetrically about 30 mc as in (b) with the two markers at the same percentage response.

Remove test equipment item 27(b).

h. To insure that the limiter interstages are acting as limiters, connect the sweep generator to 2L22, the scope to the junction of 2L40 and 2R37, and test equipment item 27(a) to 2C60. Starting with a low enough sweep generator output so that the picture viewed is a sharply peaked response, increase the output and observe that the response broadens out and reaches a limiting value. Repeat with the scope on 2V7-6.

NOTES: 1. To minimize spurious interstage coupling, the ground return connection of the sweep generator should always be kept to the left of the point at which the sweep generator is being applied (as viewed from the rear of the chassis).

2. The sweep generator output cable is to be terminated in 68 ohms at the cable end. The leads from the end of the cable to the point of use should be kept as short as possible—certainly under 2".

3. To obtain an i-f response centered around 30 mc, it may be necessary to slightly favor either band edge marker at the expense of the

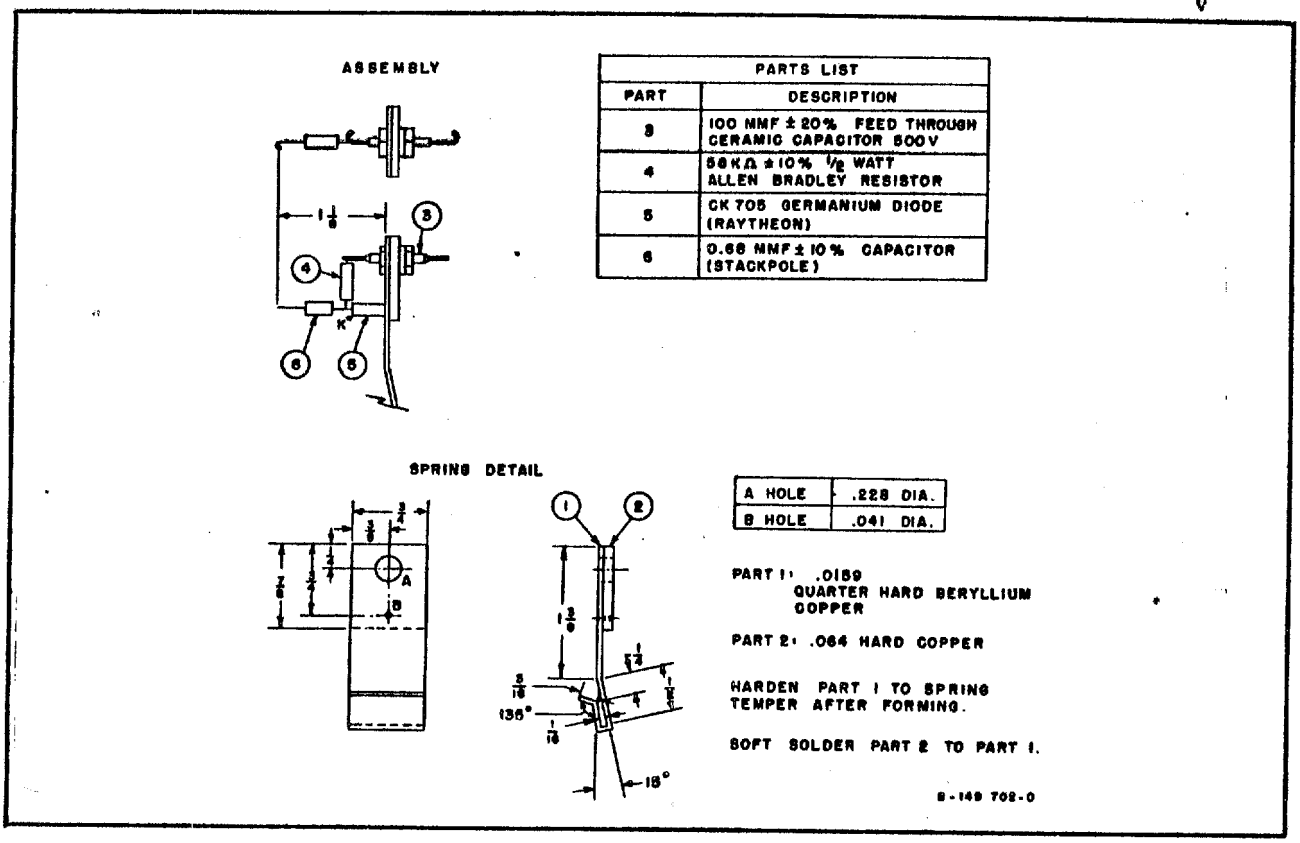


Figure RM-3—30 mc IF Alignment Jig

other. Depending upon how well the results of test (b) (IF Response Check) indicate i-f symmetry, a touch method for tuning the i-f's a bit high or low may need to be used.

R-F Test and I-F Gain Check

Insert 1N21B crystal.

CAUTION: Ground the body to the receiver chassis before inserting the crystal to prevent static discharge from damaging the crystal.

a. Apply the transmitter local oscillator frequency to 2J2. Adjust the position of 2J2 for 2J3I = 50 μa. With no input signal to the i-f or r-f note the value of 2J4E due to amplified noise. If this reading is below 0.1 volt, the i-f has insufficient gain and the quality of the i-f tubes should be investigated. The 0.1 volt reading is equivalent to a reading of 5 μa using the 200 μa test meter.

b. Maintaining the local oscillator feed at 2J3I = 50 μa attach test equipment item 16, the r-f signal generator. Note the reading of 2J4E on noise with the signal generator off. Turn on the signal generator and increase the 2J4E reading by the noise figure factor listed below (depending upon the original noise reading).

2J4E on Noise	*Noise Figure Factor*
.05 v to 0.1 v	1.6 x
0.1 v to 0.4 v	1.5 x
0.4 v to 0.8 v	1.4 x

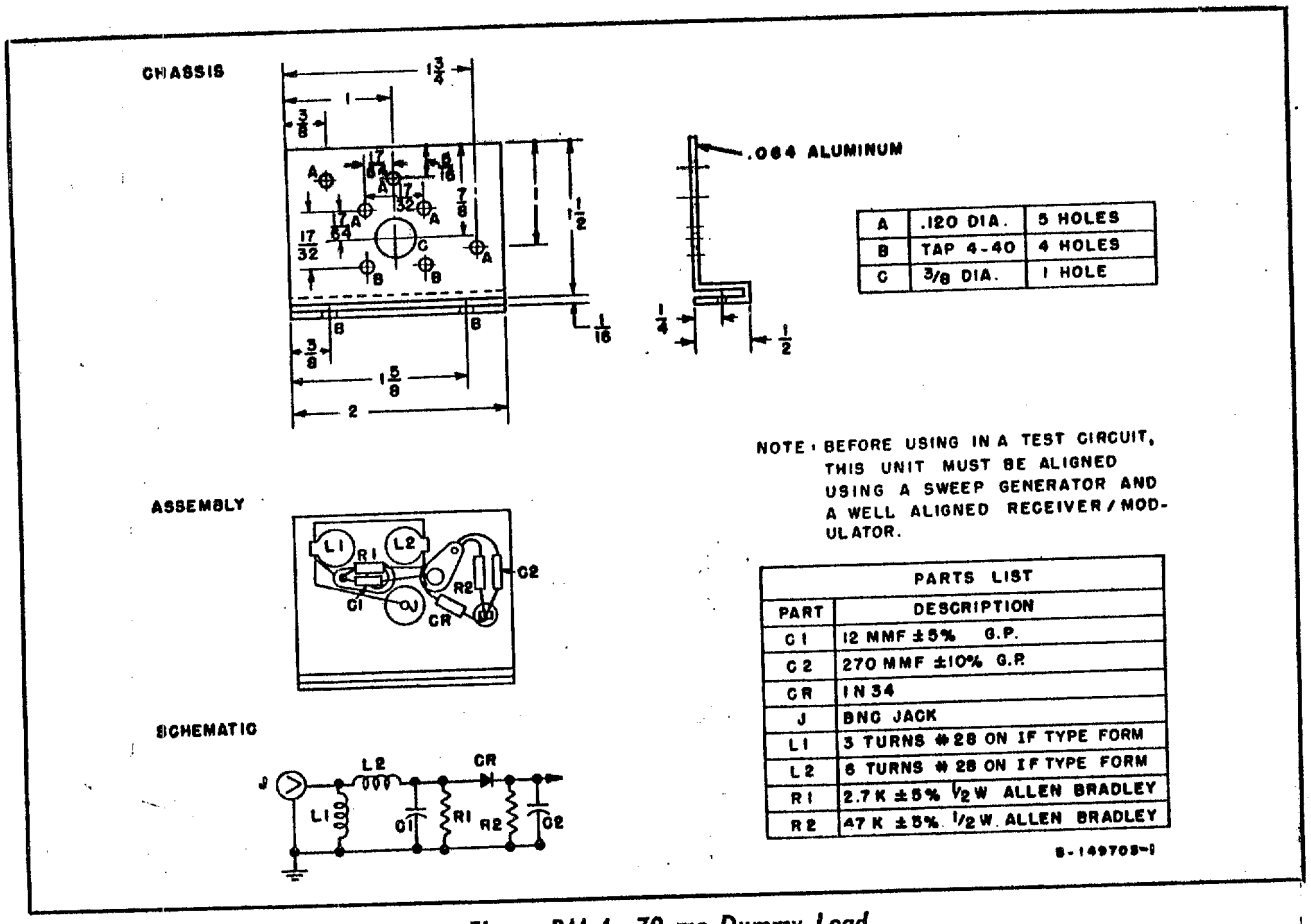
Note the signal generator reading in microvolts. It should be equal to or less than 4.2 μv. This figure corresponds to a noise figure of 12.0 db.

NOTE: For all of these tests a short, low loss r-f cable must be used to connect the r-f test equipment to the receiver.

I-F Response Check

a. Calibrate the discriminator (with the i-f cover on) by applying high level, saturating signals to the i-f at 28, 30 and 32 mc, recording the discriminator voltage for these frequencies.

Connect the r-f signal generator to 2J1 and apply a signal at the frequency of the assigned received signal. Adjust its exact frequency so that the i-f frequency is 30.0 mc and adjust the level for 2J4E = 1.0 v. Vary the signal generator frequency (keeping its output constant) and note



A	.120 DIA.	5 HOLES
B	TAP 4-40	4 HOLES
C	3/8 DIA.	1 HOLE

PARTS LIST	
PART	DESCRIPTION
C1	12 MMF ±5% G.P.
C2	270 MMF ±10% G.P.
CR	1N34
J	BNC JACK
L1	3 TURNS #28 ON IF TYPE FORM
L2	6 TURNS #28 ON IF TYPE FORM
R1	2.7K ±5% 1/2W ALLEN BRADLEY
R2	47K ±5% 1/2W ALLEN BRADLEY

B-149705-1

Figure RM-4—70 mc Dummy Load

2J4E for i-f signals of 28.0 mc and 32.0 mc. The i-f response in db, defined as

$$20 \log_{10} \frac{E(28 \text{ mc or } 32 \text{ mc})}{E(30 \text{ mc})}$$

should not vary from the 30 mc value by more than ±1.5 db.

NOTE: In this case and others when a saturating 30 mc i-f signal is desired, the maximum output of the i-f signal generator will suffice. It should be fed into the i-f strip through the hole in the cover just above the hole for the tuning slug of 2L2.

70 mc I-F Alignment

a. Connect the "70 MC OUTPUT" of the receiver/modulator to the 70 mc jack of test equipment item 27(f) using the 70 mc coaxial cable that is normally connected to the Transmitter "70 MC INPUT." (No other cable should be used.) Attach the scope to the "d-c" pin of test item 27(f) (70 mc dummy load) and the sweep generator, with 70 mc sweep at full output, to 2V11-1. Align the output network, by tuning 2L55 and 2L56 so that the response is symmetrical and the 64 mc and 76 mc pips fall at the 70% response point.

b. Connect the sweep generator to the hot end of 2L50. With the scope still on "d-c", reduce the output of the sweep generator until the observed scope picture height is roughly the same as it was in (a). Connect the scope to 2V11-6. Align 2L52, 53 and 54 as above for symmetrical response and for pips at the 70% response points.

Mixer Circuit Alignment

Using the megacycle meter (test equipment item 12), adjust the 40 mc oscillator (2V13) so that its frequency is 40.0 mc. Make sure that 2J14I (as measured with the 200 μa meter, test item 14) is reading a reasonable value—between +65 μa and +80 μa. Apply a 30.0 mc saturating signal to the 30 mc i-f. Metering the voltage at the "d-c" terminal of 70 mc dummy load, peak 2L49 and 2L50. This must be done very carefully since the maxima are quite broad. The rectified dummy load dc voltage should be 1.5 volts or greater.

Fault Oscillator/Relay Adjustment

a. Turn 2R46 maximum clockwise to insure strong oscillation of 2V14. Using the megacycle meter (test item 12) set the oscillator frequency to 110 mc. The rectified dummy load dc voltage should be 1.5 volts or greater.

b. To adjust the REL/OSC CONTROL 2R46 connect the r-f signal generator (test item 16) to 2J1. With the signal generator at zero output, plug the 1M1 meter lead into the SIG jack and note the noise reading on the test meter. Turn up the signal generator output until a reading of 20 μa plus the noise reading is obtained. Then turn the REL/OSC CONTROL fully clockwise and then carefully counter-clockwise, stopping when the relay clicks. The relay should now operate and the 110 mc oscillator become operative and inoperative as the signal is removed and reapplied.

Discriminator Alignment

a. *Remove wire "L".* Turn controls 2R107 and 2R109 on the receiver/modulator unit to maximum. Attach the distortion modulator test unit, test equipment item 11 to the receiver/modulator, putting only the 30 mc probe and the 40 mc probe in place. With the "40 mc Var" oscillator, and "40 mc Xtal" oscillator on, locate the beat between the two with the "40 mc Var" control. Note dial reading. With "40 mc Xtal" oscillator off, adjust 2L57 until the 2V13 oscillator beats with the "40 mc Var" oscillator. Turn off the "40 mc Var" oscillator.

NOTE: For all of this test the covers for both the 30 mc i-f and the oscillator-mixer section must be kept on.

b. Plug in the baseband connection. Apply the transmitter local oscillator frequency to 2J2. Adjust the position of 2J2 for 2J3I = 50 μa.

Each distortion modulation test unit is factory adjusted so that its meter (M1) will read 100 μa for $\pm$750 kc deviation when the meter is on the "35 mc Osc" position at which time it reads the tone level being supplied to the 35 mc modulator/oscillator. For an average modulator section (in the receiver/modulator unit) a 60 μa reading will result in a $\pm$750 kc deviation, with the meter switch on the "Rec-Mod" position.

Put the operation switch in the "Discr" position.

With meter on "35 mc Osc." adjust Osc. B on 50 kc for 100 μa reading. With the meter on "Rec. Mod." adjust Osc. A on 70 kc for 60 μa reading. With meter on 0 db and Osc. A changed to 30 kc, adjust "30 kc Gain" for full scale (0 db) reading. With Osc. A on the 70 kc and 80 kc positions, read the intermodulation products at 30 kc with the meter. In the 70 kc and 80 kc positions the unit is measuring the products due to third and second harmonic distortion respectively. Adjust the discriminator so that both 70 kc and 80 kc products are minimum. It should be possible to align the units so these products are below –43 db, however a value of –40 db will provide satisfactory service.

In aligning the discriminator it will be found that 2L41 primarily adjusts the high frequency peak and 2L42 primarily adjusts the low frequency peak. The 70 kc product is determined by the separation of these two peaks and the 80 kc product is determined primarily by the 2L40 tuning.

During this and the remaining intermodulation tests, the discriminator (2J5) reading must be kept on zero ($\pm$0.1 v) by varying the frequency of the test unit 35 mc oscillator. Also, in tuning the discriminator the condition shall be maintained that: *the discriminator d-c output for a saturating CW signal of 30.0 mc must be zero volts $\pm$0.1 v.*

c. Test the discriminator linearity at half deviation using essentially the same procedure as above, except use readings of ½ the above for the oscillator levels. (Readjust the "30 kc Gain" for full scale reading in this revised condition.) It should be possible to align the units so that in this case the products will be below –51 db, however, a value of –45 db will provide satisfactory service.

Modulator Alignment

a. Continuing with the test unit, change to the "overall" test position. With the meter on "Rec Mod", "Osc. A" off and "Osc. B" on 50 kc adjust the output of "Osc. B" to 60 μa. With "Osc. B" off and "Osc. A" on 70 kc adjust its output to 60 μa. With both oscillators on and Osc. A on 30 kc,

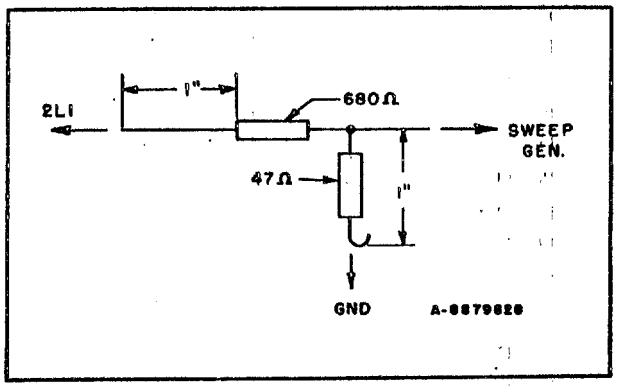


Figure RM-5—30 mc Alignment Resistor Network

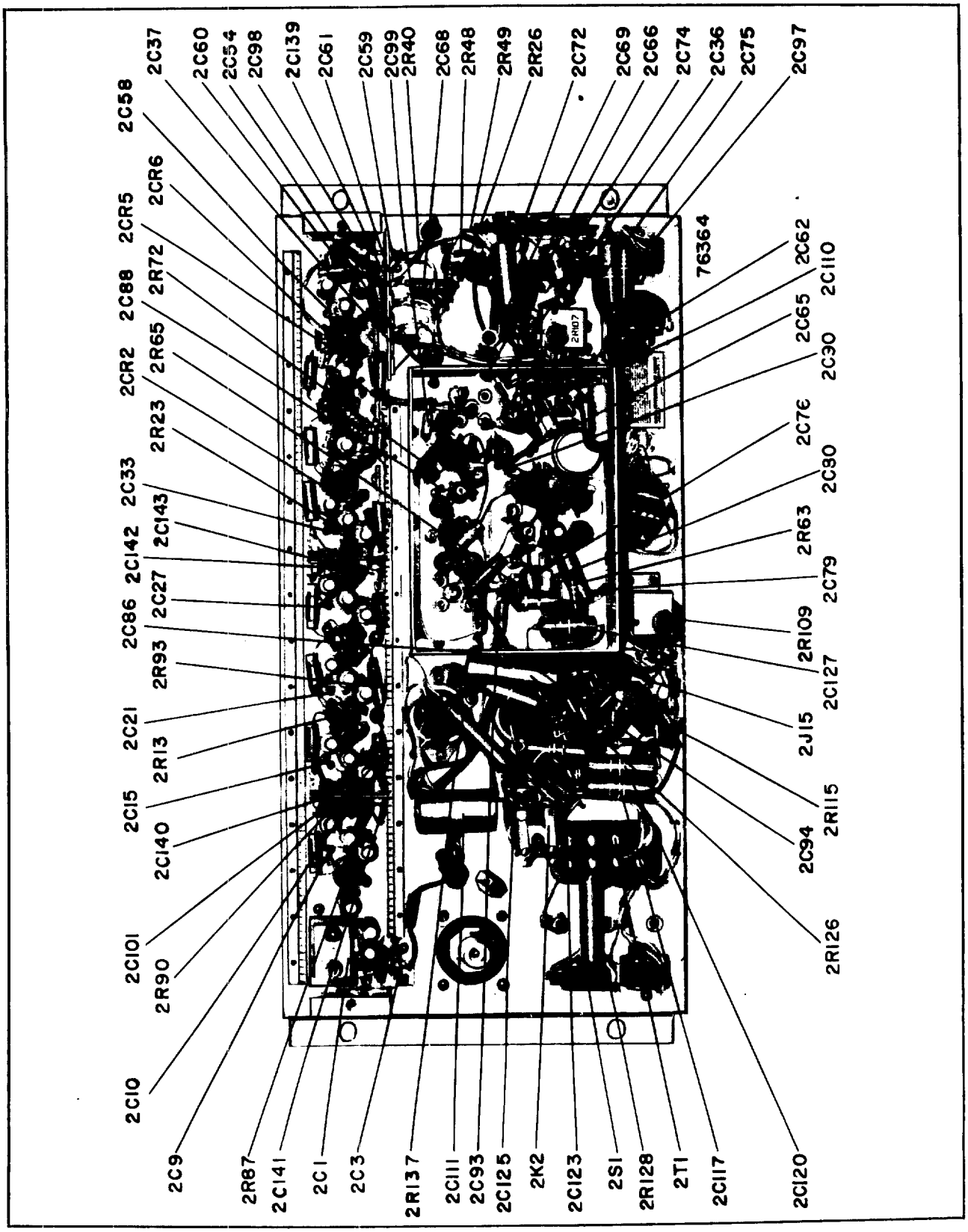


Figure RM-6—Receiver/Modulator, MI-31102-A—Rear View, Dust Cover and Shield Covers Removed

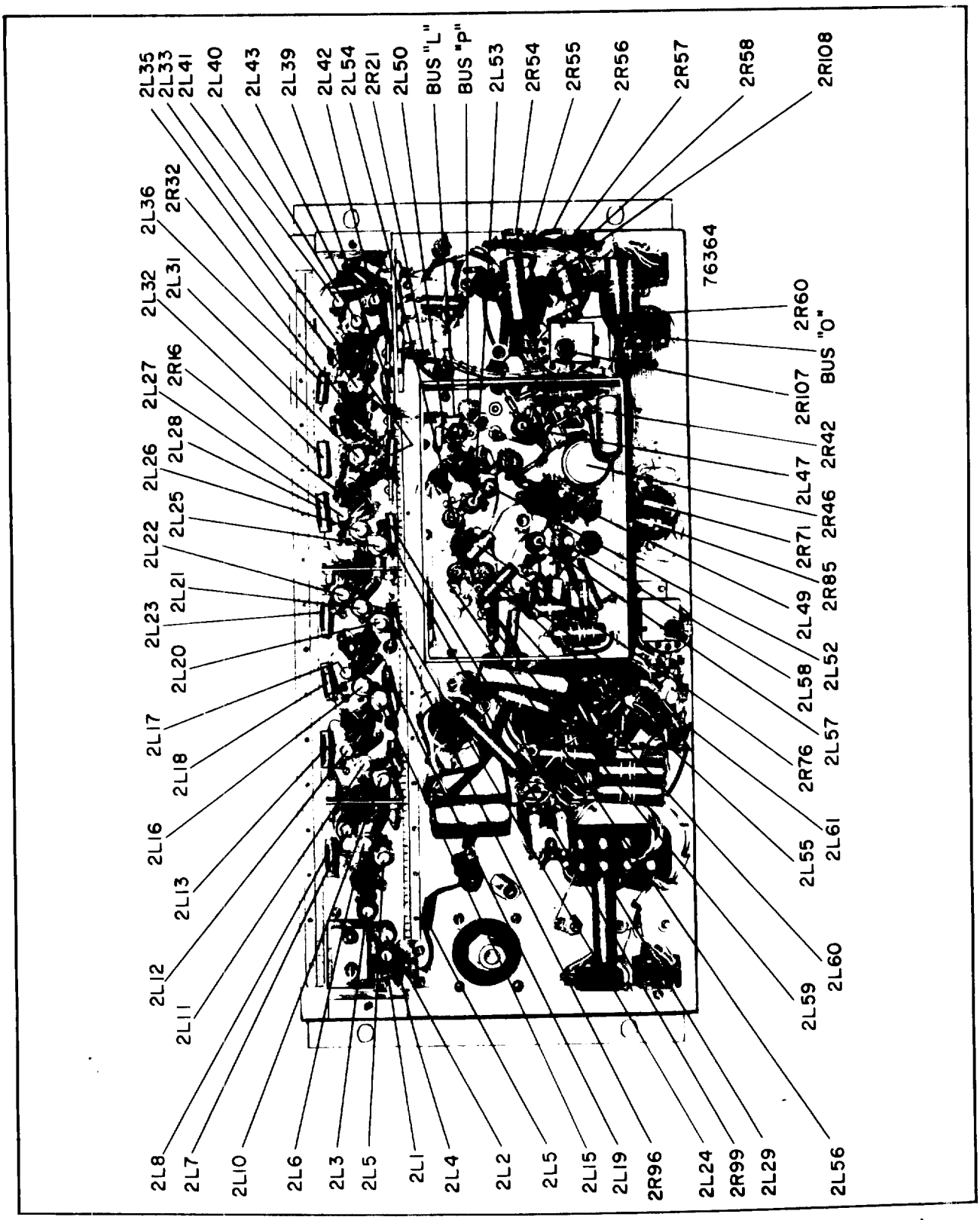


Figure RM-7—Receiver/Modulator, MI-31102-A—Rear View, Dust Cover and Shield Covers Removed

adjust "30 kc Gain" for full scale on meter "O db". With "Osc. A" on 80 kc, tune 2L58 for minimum meter reading. It should be possible to align the units so that these products are below –43 db, however a value of –40 db will provide satisfactory service.

b. Test the overall operation at half deviation using essentially the same procedure as above except using reading 30 μa. (Readjust "30 kc Gain" for full scale.) It should be possible to align the units so that in this case the products will be below –51 db, however a value of –45 db will provide satisfactory service.

NOTES. 1. Since an average reading, "X" is used for the receiver 40 mc modulator, occasionally difficulty may arise due to over-deviating an unusually sensitive modulator. If there is doubt, calibrate the individual modulator as is generally described in (c) below.

2. In all discriminator and modulator alignment tests the 200 μa test meter must *not* be connected to 2J5.

c. Connect the electronic voltmeter test equipment item 3 to 2J12-2 on the receiver/modulator. Using the test unit "40 mc Var" oscillator as a deviation meter, adjust the 30 kc level until

TYPICAL RECEIVER/MODULATOR VOLTAGE AND METER READINGS

The following are approximate voltages existing between individual tube pins and ground as measured with the Voltohmyst with a 100k resistor in series with the probe. In the case of signal-dependent voltages the left-hand value is for no signal and the right-hand value for high signal. All voltages are dc unless otherwise noted.

Tube	*Type*	*Function*	*Pin #1*	*Pin #2*	*Pin #3*	*Pin #4*	*Pin #5*	*Pin #6*	*Pin #7*	*Pin #8*	*Pin #9*
2V1	6CB6	I.F.	–.20	0	6.1 ac	0	55	55	0	—	—
2V2	6CB6	I.F.	0	1.0	6.1 ac	0	80	80	0	—	—
2V3	6CB6	I.F.	0,–1.6	1.0,1.25	6.1 ac	0	80,65	80,65	0	—	—
2V4	6CB6	I.F.	0,–2.0	1.0,1.25	6.2 ac	0	80,65	80,65	0	—	—
2V5	6CB6	I.F.	0,–2.0	1.0,1.25	6.2 ac	0	80,65	80,65	0	—	—
2V6	6CB6	I.F.	0,–2.0	1.0,1.25	6.2 ac	0	80,65	80,65	0	—	—
2V7	6CB6	I.F.	0	3.0	6.3 ac	0	100	100	0	—	—
2V8	6CB6	I.F.	0	2.5	6.3 ac	0	100	107	0	—	—
2V9	6AL5	Disc.	0	–3.4	0	6.3 ac	var.	0	–3.4	—	—
2V10	6AS6	Mixer	–1.8,–.03	.85,.55	6.3 ac	0	33,64	33,64	0	—	—
2V11	6CB6	Amp.	0	1.4	6.3 ac	0	98	98	1.4	—	—
2V12	6AH6	Mod.	3.5	7.0	6.3 ac	0	160	135	7.0	—	—
2V13	12AT7	Osc.	160	2.7	4.4	0	0	160	–2.7	4.4	6.3 ac
2V14	12AT7	Osc/Relay	26,12	0.1,2.7	1.6,1.7ac	0	0	215,250	26,12	32,24	6.3 ac
2V15	6CB6	B.B.Amp.	3.2	4.1	6.3 ac	0	210	65	4.1	—	—
2V16	12AT7	S.Ch.Amp.	74	0	1.5 ac	0	0	165	0	1.8	6.3 ac
2V17	12AX7	Lockout Amp.	125	0	1.5 ac	0	0	125	0	1.5	6.3 ac
2V18	12AT7	Lockout Amp.	90	–3.0,0	2.0 ac	0	0	200,250	33,0	35,15	6.3 ac

Voltages are positive unless noted. Var.—variable with received frequency.

The following are typical readings obtained using the 200 microamperes test meter (1M1) in the transmitter unit.

Xtal Cur.	(2J3):	–50 μa
Sig.	(2J4):	+5 μa no signal; +140 μa high signal
Disc.	(2J5):	zero for 30.0 mc I. F. signal; up to ±150 μa for off freq. signal. A typical value is ±30 μa for carrier frequencies different from 30 mc by ±1 mc.
Grid. Cur.	(2J14):	+50 μa
Lookout Cur.	(2J15):	110 μa with no signal or low signal 55 μa with 2V1 removed from the socket.

the peak deviation is exactly ±750 kc. Measure the required modulator input. Limits 0.24 v to 0.37 v rms.

Baseband Amplifier Check

a. Maintaining the conditions above, meter the 30 kc voltage on 2J12-5. Limits 0.75 v to 1.5 v.

NOTE: The components affecting this output include 2V8. If it is necessary to change 2V8 in order to pass the above test, (b) and (c) of Discriminator Alignment must be redone. As an aid to isolating low baseband output difficulties, it may be desirable to note the discriminator deviation sensitivity. This has been found to average around 0.4 v rms for a peak deviation of ±0.75 mc. This voltage is measured at 2C61 with the electronic voltmeter.

Baseband Gain Control and Modulator Gain Control Adjustments

a. Maintain the distortion and modulation test unit set up as above, except remove the lead feeding the baseband output (2J12-5) to the test unit. Place a 22,000 ohm resistor between 2J12-5 and ground to properly terminate the baseband output.

b. Using the distortion and modulation test unit 35 mc modulated oscillator or some other source of standard deviation, calibrate the discriminator determining what ac voltage it delivers when the i-f signal is deviated ±1.5 mc.

c. Apply a 5 kc tone at a level of 0.85 volts to 2J12-2. Adjust the modulator gain control 2R109 until the discriminator voltage is the value measured in (b) above.

d. Measure the voltage between 2J12-5 and ground and adjust the baseband gain control 2R107 for 1.2 volts output.

Service Channel Amplifier Check

Apply a voltage at 1 kc from test equipment item 2 to 2J12-2 exactly 20 db below that recorded in the "Modulator Alignment (c) Test. This will deviate the oscillator by ±75 kc. The service channel output from 2J13-2 into 10k ohms should then be greater than 7 volts with 2R140 at its maximum clockwise position. Adjust 2R140 for a 7 volt output.

For additional information on the use of the Distortion and Modulation Test Unit MI-31023 (test item 11) consult the instructions supplied with the unit.

If the receiver/modulator unit is to be used in a terminal station remove wire "L". Retain this connection if the unit is to be used in a repeater station. Apply core sealing material to the tops of all tuning coils except 2L47, 2L57, 2R107 and 2R109.

Standby Lockout Circuit

The standby lockout circuit is used only at standby stations. The adjustment of this circuit is described on page 53 of the CW-20A (MM-20A) Standby Switchover Instruction Book IB-24978.

REPLACEMENT PARTS LIST

RECEIVER/MODULATOR MI-31102, MI-31102-A

Symbol No.	*Description*	*Drawing No.*	*Stock No.*
2C1	Part of 2Z1.		
2C2	Capacitor, fixed, ceramic, high "K" type, 1500 mmf –0 +100%, 500 v	449696-3	73748
2C3	Capacitor, fixed, mica, 1000 mmf ±10%, 500 v	984002-121	94189
2C4	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v	735717-33	94194
2C5	Not used.		
2C6, 2C7	Capacitor, fixed, ceramic, high "K" type, 1500 mmf –0 +100%, 500 v. Same as 2C2	449696-3	73748
2C8	Not used.		
2C9	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	94194
2C10	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v	735717-427	93602
2C11	Not used.		
2C12	Capacitor, fixed, ceramic, 1000 mmf ±20%, 500 v (MI-31102 only)	984653-2	95080
2C13	Capacitor, fixed, ceramic, 1500 mmf –0 +100%, 500 v Same as 2C2	449696-3	73748
2C14	Capacitor, fixed, ceramic, 1000 mmf ±20%, 500 v. Same as 2C12 (MI-31102 only)	984653-2	95080

Symbol No.	Description	Drawing No.	Stock No.
2C15	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	94194
2C16	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v. Same as 2C10	735717-427	93602
2C17	Not used.		
2C18	Capacitor, fixed, ceramic, 1500 mmf –0 +100%, 500 v. Same as 2C2	449696-3	73748
2C19, 2C20	Not used.		
2C21	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	94194
2C22	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v. Same as 2C10	735717-427	93602
2C23	Not used.		
2C24	Capacitor, fixed, ceramic, 1500 mmf –0 +100%, 500 v. Same as 2C2	449696-3	73748
2C25, 2C26	Not used.		
2C27	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	94194
2C28	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v	735717-427	93602
2C29	Not used.		
2C30	Capacitor, fixed, ceramic, 1000 mmf ±20%, 500 v. Same as 2C12 (MI-31102 only)	984653-2	95080
2C31	Capacitor, fixed, ceramic, 1500 mmf –0 +100%, 500 v. Same as 2C2	449696-3	73748
2C32	Capacitor, fixed, ceramic, 1000 mmf ±20%, 500 v. Same as 2C12 (MI-31102 only)	984653-2	95080
2C33	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	94194
2C34	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v. Same as 2C10	735717-427	93602
2C35	Capacitor, fixed, ceramic, 1500 mmf –0 +100%, 500 v. Same as 2C2	449696-3	73748
2C36	Capacitor, fixed, ceramic, 1500 mmf –0 +20%, 500 v	8864187-2	94221
2C37	Capacitor, fixed, mica, 220 mmf ±10%, 500 v	984002-181	94222
2C38	Not used.		
2C39	Capacitor, fixed, ceramic, 1500 mmf –0 +100%, 500 v. Same as 2C2	449696-3	73748
2C40, 2C41	Not used.		
2C42	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	94194
2C43	Capacitor, fixed, ceramic, 470 mmf ±10%, 500 v	735717-37	94223
2C44	Not used.		
2C45	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v. Same as 2C10	735717-427	93602
2C46	Capacitor, fixed, ceramic, 1500 mmf –0 +100%, 500 v. Same as 2C2	449696-3	73748
2C47, 2C48	Not used.		
2C49	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	94194
2C50	Capacitor, fixed, head lead type, 4.7 mmf ±20%, 500 v	99327-6	54402
2C51	Capacitor, fixed, ceramic, 470 mmf ±10%, 500 v. Same as 2C43	735717-37	94223
2C52	Not used.		
2C53	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v. Same as 2C10	735717-427	93602
2C54	Capacitor, fixed, mica, 1000 mmf ±10%, 500 v. Same as 2C3	984002-121	94189
2C55	Capacitor, fixed, ceramic, 1500 mmf –0 +100%, 500 v. Same as 2C2	449696-3	73748
2C56, 2C57	Not used.		
2C58	Capacitor, fixed, ceramic, 22 mmf ±10%, 500 v	735717-21	59437
2C59, 2C60	Capacitor, fixed, mica, 1000 mmf ±10%, 500 v. Same as 2C3	984002-121	94189
2C61	Capacitor, fixed, mica, 50 mmf ±10%, 500 v	984002-161	94224
2C62	Capacitor, fixed, paper, 0.01 mf ±10%, 400 v	735715-163	73561
2C63, 2C64, 2C65	Capacitor, fixed, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	94194
2C66	Capacitor, fixed, ceramic, 1500 mmf –0 +20%, 500 v. Same as 2C36	8864187-2	94221
2C67	Not used.		
2C68	Capacitor, fixed, paper, 0.0047 mf ±10%, 600 v.	735715-259	73920

Symbol No.	Description	Drawing No.	Stock No.
2C69	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v	735715-175	73551
2C70	Capacitor, fixed, ceramic, 150 mmf ±10%, 500 v	735717-431	94225
2C71A/C	Capacitor, dry electrolytic, 10/10/10 mf, 450/450/450 v	449618-1	56304
2C72	Capacitor, fixed, paper, 0.068 mf ±10%, 400 v	735715-173	73792
2C73	Capacitor, fixed, ceramic, 680 mmf ±10%, 500 v	735717-439	94226
2C74	Capacitor, fixed, ceramic, 1500 mmf ±10%, 500 v	735717-443	75610
2C75	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v. Same as 2C69	735715-175	73551
2C76	Capacitor, fixed, ceramic, 470 mmf ±10%, 500 v. Same as 2C43	735717-37	94223
2C77	Capacitor, fixed, ceramic, 6.8 mmf ±1 mmf, 500 v	90581-305	39043
2C78	Capacitor, fixed, ceramic, 820 mmf –0 +100%, 500 v	449696-1	94190
2C79	Capacitor, fixed, paper, 0.047 mf ±10%, 400 v	735715-171	73553
2C80	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v. Same as 2C10	735717-427	93602
2C81	Capacitor, fixed, ceramic, 100 mmf ±10%, 500 v	735717-29	93515
2C82	Capacitor, fixed, headed lead type, 0.68 mmf ±10%, 500 v	99327-11	71504
2C83	Not used.		
2C84	Capacitor, fixed, ceramic, 1500 mmf –0 +100%, 500 v. Same as 2C2	449696-3	73748
2C85	Capacitor, fixed, ceramic, 820 mmf –0 +100%, 500 v. Same as 2C78	449696-1	94190
2C86	Capacitor, fixed, ceramic, 1500 mmf –0 +20%, 500 v. Same as 2C36	8864187-2	94221
2C87	Capacitor, fixed, ceramic, 820 mmf –0 +100%, 500 v. Same as 2C78	449696-1	94190
2C88	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	94194
2C89	Capacitor, fixed, ceramic, 820 mmf –0 +100%, 500 v. Same as 2C78	449696-1	94190
2C90	Capacitor, fixed, headed lead type, 1.5 mmf ±10%, 500 v	99327-13	71500
2C91	Capacitor, fixed, ceramic, 820 mmf –0 +100%, 500 v. Same as 2C78	449696-1	94190
2C92	Capacitor, fixed, ceramic, 470 mmf ±10%, 500 v. Same as 2C43	735717-37	94223
2C93, 2C94	Capacitor, fixed, ceramic, 1500 mmf. +20 –0%, 500 v. Same as 2C36	8864187-2	94221
2C95	Capacitor, fixed, ceramic, 10 mmf ±20%, 500 v	8892567-4	94227
2C96	Not used.		
2C97	Capacitor, fixed, paper, 0.033 mf ±10%, 400 v	735715-169	73552
2C98	Capacitor, fixed, ceramic, 12 mmf ±10%, 500 v.	735717-418	94228
2C99	Capacitor, fixed, ceramic, 68 mmf ±10%, 500 v. Same as 2C10	735717-427	93602
2C100	Capacitor, fixed, ceramic, 390 mmf ±10%, 500 v	735717-436	75641
2C101 to 2C103	Capacitor, fixed, ceramic, 1500 mmf –0 +100%, 500 v. Same as 2C2	449696-3	73748
2C104	Capacitor, fixed, ceramic, 1500 mmf –0 +20%, 500 v. Same as 2C36	8864187-2	94221
2C105, 2C106	Capacitor, fixed, ceramic, 1500 mmf –0 +100%, 500 v. Same as 2C2	449696-3	73748
2C107	Capacitor, fixed, ceramic, 1500 mmf –0 +20%, 500 v. Same as 2C36	8864187-2	94221
2C108, 2C109	Capacitor, fixed, ceramic, 1500 mmf –0 +100%, 500 v. Same as 2C2	449696-3	73748
2C110	Capacitor, fixed, headed lead type, 1.0 mmf ±10%, 500 v	99327-12	55331
2C111	Capacitor, dry electrolytic, 40 mf, 150 v	442901-160	59417
2C112, 2C113	Capacitor, fixed, ceramic, 1500 mmf –0 +100%, 500 v. Same as 2C2	449696-3	73748
2C114	Capacitor, fixed, mica, 820 mmf ±5%, 500 v	727868-245	39650
2C115, 2C116	Capacitor, fixed, ceramic, 10,000 mmf +100 –0%, 450 v	449696-55	59997
2C117	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v. Same as 2C69	735715-175	73551
2C118	Capacitor, fixed, ceramic, 220 mmf ±10%, 500 v. Same as 2C4	735717-33	94194
2C119	Capacitor, fixed, ceramic, 10,000 ohms +100 –0%, 450 v. Same as 2C115	449696-55	59997
2C120	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v. Same as 2C69	735715-175	73551
2C121, 2C122	Capacitor, fixed, ceramic, 10,000 mmf +100 –0%, 450 v. Same as 2C115	449696-55	59997
2C123	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v. Same as 2C69	735715-175	73551
2C124	Capacitor, fixed, ceramic, 10,000 mmf +100 –0%, 450 v. Same as 2C115	449696-55	59997
2C125	Capacitor, fixed, paper, 0.047 mf ±10%, 200 v	735715-71	73558

Symbol No.	*Description*	*Drawing No.*	*Stock No.*
2C126	Capacitor, fixed, headed lead type, 4.7 mmf ±20%, 500 v. Same as 2C50	99327-6	54402
2C127	Capacitor, fixed, paper, 0.047 mf ±10%, 400 v. Same as 2C79	735715-171	73553
2C128	Capacitor, fixed, ceramic, 680 mmf ±10%, 500 v. Same as 2C73	735717-439	94226
2C129	Capacitor, fixed, ceramic, 1500 mmf +100 –0%, 500 v. Same as 2C2	449696-3	73748
2C130	Capacitor, fixed, ceramic, 220 mmf +100 –0%, 500 v	990167-9	77625
2C131	Capacitor, fixed, ceramic, 1500 mmf +100 –0%, 500 v. Same as 2C2	449696-3	73748
2C132, 2C133	Capacitor, fixed, ceramic, 1000 mmf +100 –20%, 500 v	449696-2	77252
2C134	Capacitor, fixed, ceramic, 1500 mmf +100 –0%, 500 v. Same as 2C2	449696-3	73748
2C135, 2C136	Capacitor, fixed, ceramic, 1000 mmf +100 –20%, 500 v. Same as 2C132	449696-2	77252
2C137	Capacitor, fixed, ceramic, 1500 mmf +100 –0%, 500 v. Same as 2C2	449696-3	73748
2C138	Capacitor, fixed, ceramic, 1000 mmf +100 –20%, 500 v. Same as 2C132	449696-2	77252
2C139	Capacitor, fixed, silver mica, 1000 mmf ±10%, 500 v. Same as 2C3 (MI-31102-A only)	984002-121	94189
2C140 to 2C143	Capacitor, fixed, ceramic, feed thru, 1000 mmf ±20%, 500 v. (MI-31102-A only)	8825449-1	99177
2C144, 2C145	Capacitor, fixed, headed lead type, 4.7 mmf ±20%, 500 v. Same as 2C50	99327-6	54402
2CR1	Rectifier, crystal, diode 1N21B	1N21B	67876
2CR2 to 2CR7, incl.	Rectifier, crystal, diode CK705	CK705	94229
2J1	Connector, female, coaxial chassis mtd. (MI-31102 only)	8834429-501	94230
2J1	Connector, male, coaxial chassis mtd. (MI-31102-A only)	456961-501	95392
2J2	Coupling, special, comprising 1 female, chassis mtd. coaxial connector, sleeve and 33 ohm, ½ w. resistor	8834436-501	94231
2J3 to 2J5	Connector, pin jack	742565-1	93678
2J6	Not used.		
2J7	Connector, pin jack. Same as 2J3	742565-1	93678
2J8, 2J9	Connector, female, coaxial, chassis mtd.	8845666-1	94205
2J10	Not used.		
2J11	Connector, male, 6 contact, chassis mtg. type	181494-3	28507
2J12	Connector, female, 6 contact, chassis mtg. type	181494-4	18534
2J13	Connector, male, 6 contact, chassis mtg. type. Same as 2J11	181494-3	28507
2J14, 2J15	Connector, pin jack. Same as 2J3	742565-1	93678
2K1	Relay, dc coil res. 8000 ohm, s.p.d.t. contacts, plug-in type	8888583-1	56316
2K2	Relay, ac midget type, coil 115 v., d.p.d.t. contacts	458952-1	95350
2K3	Relay, ac coil res. 8000 ohm, s.p.d.t. contacts, plug-in type. Same as 2K1	8888583-1	56316
2L1	Coil, iron core, adjustable, 18 turns of 0.0080 dia. wire on phenolic form	629132-511	94233
2L2	Coil, iron core, adjustable, 32 turns of wire on phenolic form	629132-506	94234
2L3	Coil, iron core, adjustable, 22 turns of wire on phenolic form	629132-509	94235
2L4	Reactor, r-f choke, 7.5 microhenry	459688-76	205050
2L5	Coil, iron core, adjustable, 33 turns of wire on phenolic form	629132-505	94236
2L6	Coil, iron core, adjustable, 40 turns of wire on phenolic form	629132-503	94237
2L7	Coil, iron core, adjustable, 19 turns of wire on phenolic form	629132-510	94238
2L8	Reactor, iron core, 2.4 microhenry	8834424-501	94040
2L9	Not used.		
2L10	Coil, iron core, adjustable, 33 turns of wire on phenolic form. Same as 2L5	629132-505	94236
2L11	Coil, iron core, adjustable, 40 turns of wire on phenolic form. Same as 2L6	629132-503	94237

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Symbol No.	Description	Drawing No.	Stock No.
2L12	Coil, iron core, adjustable, 19 turns of wire on phenolic form. Same as 2L7	629132-510	94238
2L13	Reactor, iron core, 2.4 microhenry. Same as 2L8	8834424-501	94040
2L14	Reactor, r-f choke, 7.5 microhenry. Same as 2L4	459688-76	205050
2L15	Coil, iron core, adjustable, 33 turns of wire on phenolic form. Same as 2L5	629132-505	94236
2L16	Coil, iron core, adjustable, 40 turns of wire on phenolic form. Same as 2L6	629132-503	94237
2L17	Coil, iron core, adjustable, 19 turns of wire on phenolic form. Same as 2L7	629132-510	94238
2L18	Reactor, iron core, 2.4 microhenry. Same as 2L8	8834424-501	94040
2L19	Reactor, r-f choke, 7.5 microhenry. Same as 2L4	459688-76	205050
2L20	Coil, iron core, adjustable, 33 turns of wire on phenolic form. Same as 2L5	629132-505	94236
2L21	Coil, iron core, adjustable, 40 turns of wire on phenolic form. Same as 2L6	629132-503	94237
2L22	Coil, iron core, adjustable, 19 turns of wire on phenolic form. Same as 2L7	629132-510	94238
2L23	Reactor, iron core, 2.4 microhenry. Same as 2L8	8834424-501	94040
2L24	Reactor, r-f choke, 7.5 microhenry. Same as 2L4	459688-76	205050
2L25	Coil, iron core, adjustable, 33 turns of wire on phenolic form. Same as 2L5	629132-505	94236
2L26	Coil, iron core, adjustable, 40 turns of wire on phenolic form. Same as 2L6	629132-503	94237
2L27	Coil, iron core, adjustable, 19 turns of wire on phenolic form. Same as 2L7	629132-510	94238
2L28	Reactor, iron core, 2.4 microhenry. Same as 2L8	8834424-501	94040
2L29, 2L30	Reactor, r-f choke, 7.5 microhenry. Same as 2L4	459688-76	205050
2L31	Coil, iron core, adjustable, 15 turns of wire on phenolic form	629132-526	94210
2L32	Reactor, iron core, 2.4 microhenry. Same as 2L8	8834424-501	94040
2L33, 2L34	Reactor, r-f choke, 7.5 microhenry. Same as 2L4	459688-76	205050
2L35	Coil, iron core, adjustable, 14 turns of wire on phenolic form	629132-527	94239
2L36	Reactor, iron core, 2.4 microhenry. Same as 2L8	8834424-501	94040
2L37 to 2L39	Reactor, r-f choke, 7.5 microhenry. Same as 2L4	459688-76	205050
2L40	Coil, iron core, adjustable, 28 turns of wire on phenolic form	629132-507	94240
2L41	Coil, iron core, adjustable, 22 turns of wire on phenolic form. Same as 2L3	629132-509	94235
2L42	Coil, iron core, adjustable, 32 turns of wire on phenolic form with conductive cloth covering	629132-528	96463
2L43	Reactor, air core, 50 microhenry	8834437-502	94242
2L44	Reactor, iron core, 2.4 microhenry. Same as 2L8	8834424-501	94040
2L45, 2L46	Reactor, r-f choke, 7.5 microhenry. Same as 2L4	459688-76	205050
2L47	Coil, iron core, adjustable, 6 turns of wire on phenolic form	629132-520	94211
2L48	Not used.		
2L49, 2L50	Coil, iron core, adjustable, 16 turns of wire on phenolic form	629132-513	94241
2L51	Reactor, r-f choke, 7.5 microhenry. Same as 2L4	459688-76	205050
2L52	Coil, iron core, adjustable, 13 turns of wire on phenolic form	629132-514	94244
2L53	Coil, iron core, adjustable, 22 turns of wire on phenolic form. Same as 2L3	629132-509	94235
2L54	Coil, iron core, adjustable, 8 turns of wire on phenolic form	629132-517	94245
2L55	Coil, iron core, adjustable, 10 turns of wire on phenolic form	629132-516	94246
2L56	Coil, iron core, adjustable, 4 turns of wire on phenolic form	629132-524	94208
2L57	Coil, iron core, adjustable, 11 turns of wire on phenolic form	629132-535	94247

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Symbol No.	Description	Drawing No.	Stock No.
2L58	Coil, iron core, adjustable, 14 turns of wire on phenolic form. Same as 2L35	629132-527	94239
2L59	Reactor, iron core, 2.4 microhenry. Same as 2L8	8834424-501	94040
2L60	Reactor, r-f choke, 7.5 microhenry. Same as 2L4	459688-76	205050
2L61	Reactor, air core, 7.0 microhenry	8834437-503	97345
2L62	Reactor, air core, 6 turns of wire on coil form	8834423-502	95885
2L63	Coil, air core, 11 turns of wire on coil form	8834423-503	98387
2R1	Not used.		
2R2	Resistor, fixed, composition, 4700 ohms ±5%, ½ w	82283-175	502247
2R3 to 2R5	Not used.		
2R6	Resistor, fixed, composition, 33 ohm ±10%, ½ w (also part of 2J2)	82283-44	30789
2R7	Not used.		
2R8	Resistor, fixed, composition, 4700 ohm ±5%, ½ w. Same as 2R2	82283-175	502247
2R9, 2R10	Not used.		
2R11	Resistor, fixed, composition, 68 ohm ±5%, ½ w	82283-131	502068
2R12	Not used.		
2R13	Resistor, fixed, composition, 4700 ohm ±5%, ½ w. Same as 2R2	82283-175	502247
2R14, 2R15	Not used.		
2R16	Resistor, fixed, composition, 150 ohm ±10%, ½ w	82283-52	502115
2R17	Not used.		
2R18	Resistor, fixed, composition, 4700 ohm ±5%, ½ w. Same as 2R2	82283-175	502247
2R19, 2R20	Not used.		
2R21	Resistor, fixed, composition, 27,000 ohm ±5%, ½ w	82283-193	502327
2R22	Not used.		
2R23	Resistor, fixed, composition, 4700 ohm ±5%, ½ w. Same as 2R2	82283-175	502247
2R24	Not used.		
2R25	Resistor, fixed, composition, 470 ohm ±10%, ½ w	82283-58	30499
2R26	Resistor, fixed, composition, 100 ohm ±10%, ½ w	82283-50	502110
2R27	Resistor, fixed, composition, 1000 ohm ±10%, ½ w	82283-62	502210
2R28	Not used.		
2R29, 2R30	Resistor, fixed, composition, 390 ohm ±10%, ½ w	82283-57	30498
2R31	Resistor, fixed, composition, 3900 ohm ±5%, ½ w	82283-173	502239
2R32	Resistor, fixed, composition, 12,000 ohm ±10%, 1 w	90496-75	512312
2R33, 2R34	Resistor, fixed, composition, 390 ohm ±10%, ½ w. Same as 2R29	82283-57	30498
2R35	Resistor, fixed, composition, 3900 ohm ±5%, ½ w. Same as 2R31	82283-173	502239
2R36	Resistor, fixed, composition, 12,000 ohm ±10%, 1 w. Same as 2R32	90496-75	512312
2R37	Resistor, fixed, composition, 2200 ohm ±5%, ½ w	82283-167	502222
2R38, 2R39	Resistor, fixed, composition, 3300 ohm ±5%, ½ w	82283-171	30733
2R40	Resistor, fixed, composition, 27,000 ohm ±5%, ½ w. Same as 2R21	82283-193	502327
2R41	Resistor, fixed, composition, 470,000 ohm ±10%, ½ w	82283-94	502447
2R42	Resistor, fixed, wire wound, 22,000 ohm ±5%, 5 w	428781-38	59175
2R43, 2R44	Resistor, fixed, composition, 1 meg ±10%, ½ w	82283-98	502510
2R45	Resistor, fixed, composition, 560,000 ohm ±10%, ½ w	82283-95	502456
2R46	Resistor, variable, carbon, 25,000 ohm ±10%, 2 w	737829-31	94192
2R47	Resistor, fixed, composition, 2200 ohm ±10%, 1 w	90496-66	512222
2R48	Resistor, fixed, composition, 1 meg ±10%, ½ w. Same as 2R43	82283-98	502510
2R49	Resistor, fixed, composition, 120 ohm ±5%, ½ w	82283-137	502112
2R50	Resistor, fixed, composition, 470 ohm ±5%, ½ w	82283-151	30499
2R51	Not used.		
2R52	Resistor, fixed, composition, 100,000 ohm ±5%, ½ w	82283-207	502410
2R53	Resistor, fixed, composition, 1000 ohm ±5%, ½ w	82283-159	502210
2R54	Resistor, fixed, composition, 220,000 ohm ±5%, ½ w	82283-215	502422

Symbol No.	Description	Drawing No.	Stock No.
2R55	Resistor, fixed, composition, 470,000 ohm ±5%, ½ w	82283-223	502447
2R56	Resistor, fixed, composition, 270,000 ohm ±5%, ½ w	82283-217	502427
2R57	Resistor, fixed, composition, 150,000 ohm ±5%, ½ w	82283-211	502415
2R58	Resistor, fixed, composition, 180,000 ohm ±5%, ½ w	82283-213	502418
2R59	Resistor, fixed, composition, 390 ohm ±5%, ½ w	82283-149	30498
2R60	Resistor, fixed, composition, 18,000 ohm ±10%, 2 w	99126-77	39158
2R61	Resistor, fixed, composition, 10,000 ohm ±5%, ½ w	82283-183	502310
2R62	Resistor, fixed, composition, 100,000 ohm ±5%, ½ w. Same as 2R52	82283-207	502410
2R63	Resistor, fixed, composition, 100,000 ohm ±5%, 1 w	90496-207	512410
2R64	Not used.		
2R65	Resistor, fixed, composition, 47,000 ohm ±5%, 2 w	99126-199	44211
2R66	Not used.		
2R67	Resistor, fixed, composition, 22,000 ohm ±5%, ½ w	82283-191	502322
2R68	Resistor, fixed, composition, 1500 ohm ±5%, ½ w	82283-163	502215
2R69	Resistor, fixed, composition, 120 ohm ±5%, ½ w. Same as 2R49	82283-137	502112
2R70	Resistor, fixed, composition, 1000 ohm ±5%, ½ w. Same as 2R53	82283-159	502210
2R71	Resistor, fixed, composition, 4700 ohm ±5%, 2 w	99126-175	522247
2R72	Resistor, fixed, composition, 39,000 ohm ±10%, 2 w	99126-81	522339
2R73	Resistor, fixed, composition, 4700 ohm ±5%, ½ w. Same as 2R2	82283-175	502247
2R74	Resistor, fixed, composition, 2700 ohm ±5%, ½ w	82283-169	502227
2R75	Resistor, fixed, composition, 220 ohm ±5%, ½ w	82283-143	502122
2R76	Resistor, fixed, composition, 22,000 ohm ±10%, 2 w	99126-78	522322
2R77	Resistor, fixed, composition, 5600 ohm ±5%, ½ w	82283-177	502256
2R78	Not used.		
2R79	Resistor, fixed, wire wound, 1500 ohm ±10%, 10 w (MI-31102 only)	844908-19	47493
2R80, 2R81	Not used.		
2R82	Resistor, fixed, composition, 2700 ohm ±5%, ½ w. Same as 2R74	82283-169	502227
2R83	Resistor, fixed, composition, 100,000 ohm ±5%, ½ w. Same as 2R52	82283-207	502410
2R84	Resistor, fixed, composition, 1 meg ±10%, ½ w. Same as 2R43 (MI-31102 only)	82283-98	502510
2R85	Resistor, fixed, composition, 27,000 ohm ±10%, 2 w	99126-79	522327
2R86	Resistor, fixed, composition, 100,000 ohm ±10%, ½ w	82283-86	502410
2R87	Resistor, fixed, composition, 10,000 ohm ±10%, 1 w	90496-74	512310
2R88	Resistor, fixed, composition, 2200 ohm ±5%, ½ w. Same as 2R37	82283-167	502222
2R89	Resistor, fixed, composition, 150 ohm ±10%, ½ w. Same as 2R16	82283-52	502115
2R90	Resistor, fixed, composition, 10,000 ohm ±10%, 1 w. Same as 2R87	90496-74	512310
2R91	Resistor, fixed, composition, 2200 ohm ±5%, ½ w. Same as 2R37	82283-167	502222
2R92	Resistor, fixed, composition, 150 ohm ±10%, ½ w. Same as 2R16	82283-52	502115
2R93	Resistor, fixed, composition, 10,000 ohm ±10%, 1 w. Same as 2R87	90496-74	512310
2R94	Resistor, fixed, composition, 2200 ohm ±5%, ½ w. Same as 2R37	82283-167	502222
2R95	Resistor, fixed, composition, 150 ohm ±10%, ½ w. Same as 2R16	82283-52	502115
2R96	Resistor, fixed, composition, 10,000 ohm ±10%, 1 w. Same as 2R87	90496-74	512310
2R97	Resistor, fixed, composition, 2200 ohm ±5%, ½ w. Same as 2R37	82283-167	502222
2R98	Resistor, fixed, composition, 150 ohm ±10%, ½ w. Same as 2R16	82283-52	502115
2R99	Resistor, fixed, composition, 10,000 ohm ±10%, 1 w. Same as 2R87	90496-74	512310
2R100	Resistor, fixed, composition, 2200 ohm ±5%, ½ w. Same as 2R37	82283-167	502222
2R101	Resistor, fixed, composition, 10,000 ohm ±10%, 1 w. Same as 2R87	90496-74	512310
2R102	Resistor, fixed, composition, 100 ohm ±10%, ½ w. Same as 2R26	82283-50	502110
2R103, 2R104	Resistor, fixed, composition, 560 ohm ±10%, ½ w	82283-59	5164
2R105, 2R106	Resistor, fixed, composition, 4700 ohm ±5%, ½ w. Same as 2R2	82283-175	502247

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Symbol No.	*Description*	*Drawing No.*	*Stock No.*
2R107	Resistor, variable, composition, 5000 ohm ±10%, 2 w	737829-30	94039
2R108	Resistor, fixed, composition, 2200 ohm ±5%, ½ w. Same as 2R37	82283-167	502222
2R109	Resistor, variable, composition, 10,000 ohm ±10%, 2 w	737801-44	58983
2R110	Resistor, fixed, composition, 4700 ohm ±5%, ½ w. Same as 2R2	82283-175	502247
2R111	Resistor, fixed, composition, 470,000 ohm ±10%, ½ w. Same as 2R41	82283-94	502447
2R112	Resistor, fixed, composition, 3900 ohm ±5%, ½ w. Same as 2R31	82283-173	502239
2R113	Resistor, fixed, composition, 220,000 ohm ±5%, ½ w. Same as 2R54	82283-215	502422
2R114	Resistor, fixed, composition, 100,000 ohm ±10%, ½ w. Same as 2R86	82283-86	502410
2R115	Resistor, variable, composition, 1 meg ±20%, 2 w	746053-22	98077
2R116	Resistor, fixed, composition, 3900 ohm ±5%, ½ w. Same as 2R31	82283-173	502239
2R117	Resistor, fixed, composition, 220,000 ohm ±5%, ½ w. Same as 2R54	82283-215	502422
2R118	Resistor, fixed, composition, 100,000 ohm ±10%, ½ w. Same as 2R86	82283-86	502410
2R119	Resistor, fixed, composition, 680,000 ohm ±10%, ½ w	82283-96	30562
2R120	Resistor, fixed, composition, 3900 ohm ±5%, ½ w. Same as 2R31	82283-173	502239
2R121	Resistor, fixed, composition, 220,000 ohm ±5%, ½ w. Same as 2R54	82283-215	502422
2R122	Resistor, fixed, composition, 100,000 ohm ±10%, ½ w. Same as 2R86	82283-86	502410
2R123	Resistor, fixed, composition, 560,000 ohm ±10%, ½ w. Same as 2R45	82283-95	502456
2R124	Resistor, fixed, composition, 3300 ohm ±5%, ½ w. Same as 2R38	82283-171	30733
2R125	Resistor, fixed, composition, 270,000 ohm ±5% ½ w. Same as 2R56	82283-217	502427
2R126	Resistor, fixed, wire wound, 560,000 ohm ±5%, 10 w	428781-54	53702
2R127	Resistor, fixed, composition, 470,000 ohm ±10%, ½ w. Same as 2R41	82283-94	502447
2R128	Resistor, fixed, wire wound, 75 ohm ±10%, 20 w	8811127-1	16239
2R129	Resistor, fixed, composition, 15,000 ohm ±5%, ½ w	82283-187	36714
2R130	Resistor, fixed, composition, 68,000 ohm ±5%, 1 w	90496-203	512368
2R131	Resistor, fixed, carbon film type, 1000 ohm ±1%, ½ w	984059-159	203901
2R132	Resistor, fixed, composition, 390,000 ohm ±5%, ½ w	82283-221	502439
2R133	Resistor, fixed, carbon film type, 180 ohm ±1%, ½ w	984059-141	203902
2R134	Resistor, fixed, carbon film type, 330 ohm ±1%, ½ w	984059-147	95324
2R135	Resistor, fixed, composition, 10 ohm ±5%, ½ w	82283-111	502010
2R136	Resistor, fixed, composition, 1000 ohm ±5%, ½ w	82283-159	502210
2R137	Resistor, fixed, wire wound, 1750 ohm ±10%, 25 w (MI-31102-A only)	8817665-21	206726
2R138	Resistor, fixed, composition, 10,000 ohm ±10%, 2 w (MI-31102-A only)	99126-74	522310
2R139	Resistor, fixed, composition, 470,000 ohm ±10%, ½ w. Same as 2R41 (MI-31102-A only)	82283-94	502447
2R140	Resistor, variable, composition, 500,000 ohm ±20%, 0.2 w (MI-31102-A only)	737887-12	206494
2S1	Switch, push type, s.p.d.t.	8835332-2	95572
2T1	Transformer, filament	8874796-1	57650
2X1 to 2X12, incl.	Socket, tube, 7 pin, miniature	99370-2	53539
2X13, 2X14	Socket, tube, 9 pin, miniature	984055-2	56333
2X15	Socket, tube, 7 pin, miniature. Same as 2X1	99370-2	53539
2X16 to 2X18	Socket, tube, 9 pin, miniature. Same as 2X13	984055-2	56333
2X19, 2X20	Socket, tube, 5 contact	849224-1	43639
2X21	Socket, tube, octal, red bakelite	181516-2	45368
2Z1	Cavity Assembly—(not stocked complete) (associated parts below)	458907-501 (MI-31102) 458907-502 (MI-31102-A)	
	Core, brass tuning #3/8-24 thread, 1 1/16" lg., 2Z1 tuning	8831031-1	95393
	Contact, beryllium copper, for 2Z1	8834416-1	94390
	Insulator, teflon coated glass fabric, 1 3/16" x 1 3/16" x 0.010 thick, 1 hole 0.257 dia. in center and 2 holes, 0.128 dia. on long axis (4 req'd)	8834415-1	94389

	Description	*Drawing No.*	*Stock No.*
	Washer, spring, 7/8" O.D. x 21/32" I.D. x 0.025 thick beryllium copper, tuning core tension	8831068-2	95394
	Nut, hex, brass #3/8-24 thread tuning core locking	874927-6	95395
	Miscellaneous		
	Connector, male, coaxial, cable mtg. type	8898625-501	54392
	Screw, thumb, back panel holding	8886111-2	94391
	Shield, tube, 7 pin miniature, 1¾" lg.	99369-2	54521
	Shield, tube, 7 pin miniature, 1⅜" lg.	99369-1	54428
	Shield, tube, 9 pin, 1 15/16" lg.	8858642-3	57533

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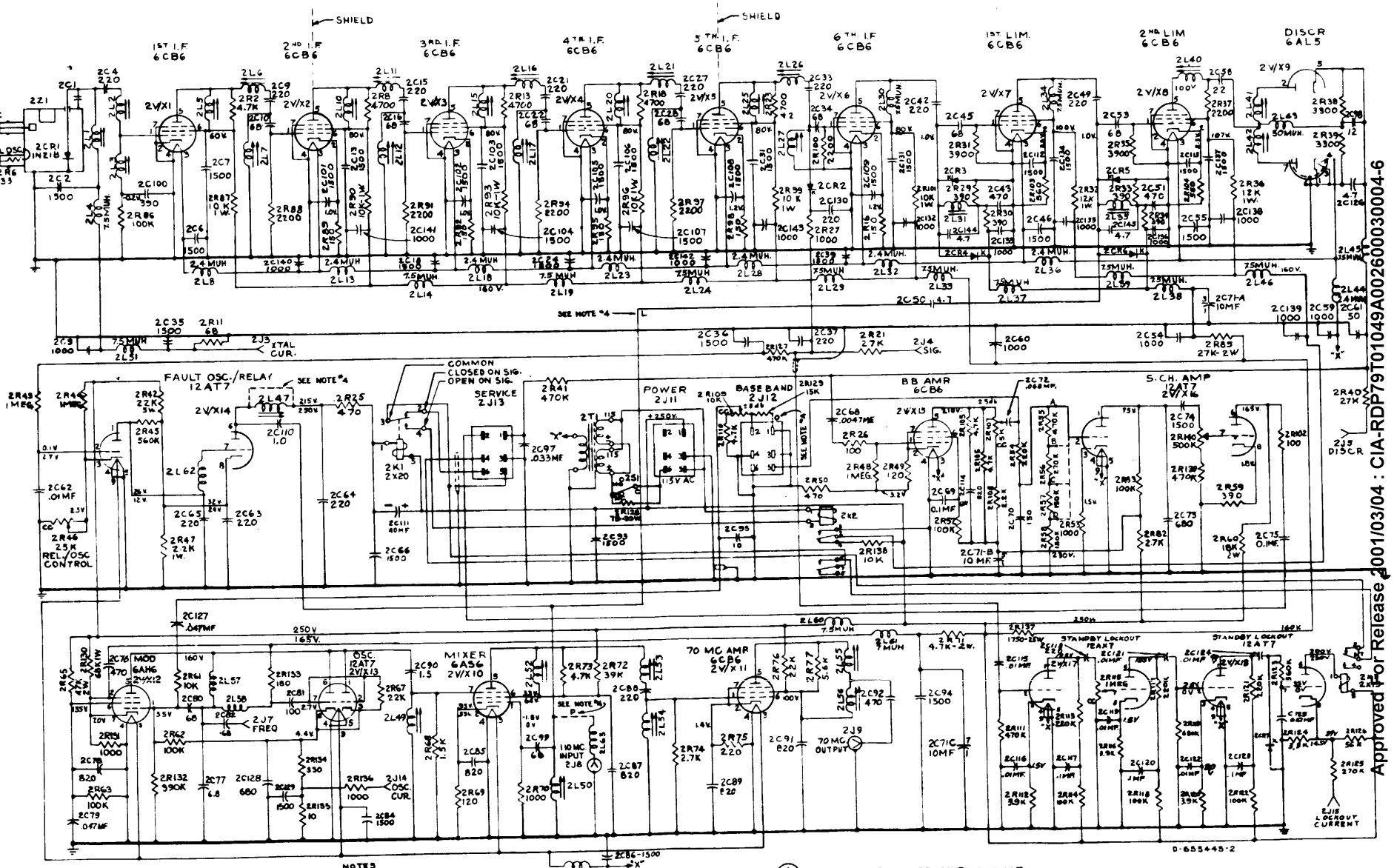


NOTES

*1 TUBES 2V17 & 2V18 AND RELAY 2K3 ARE OMITTED WHEN RECEIVER IS OPERATED WITHOUT STANDBY EQUIPMENT.

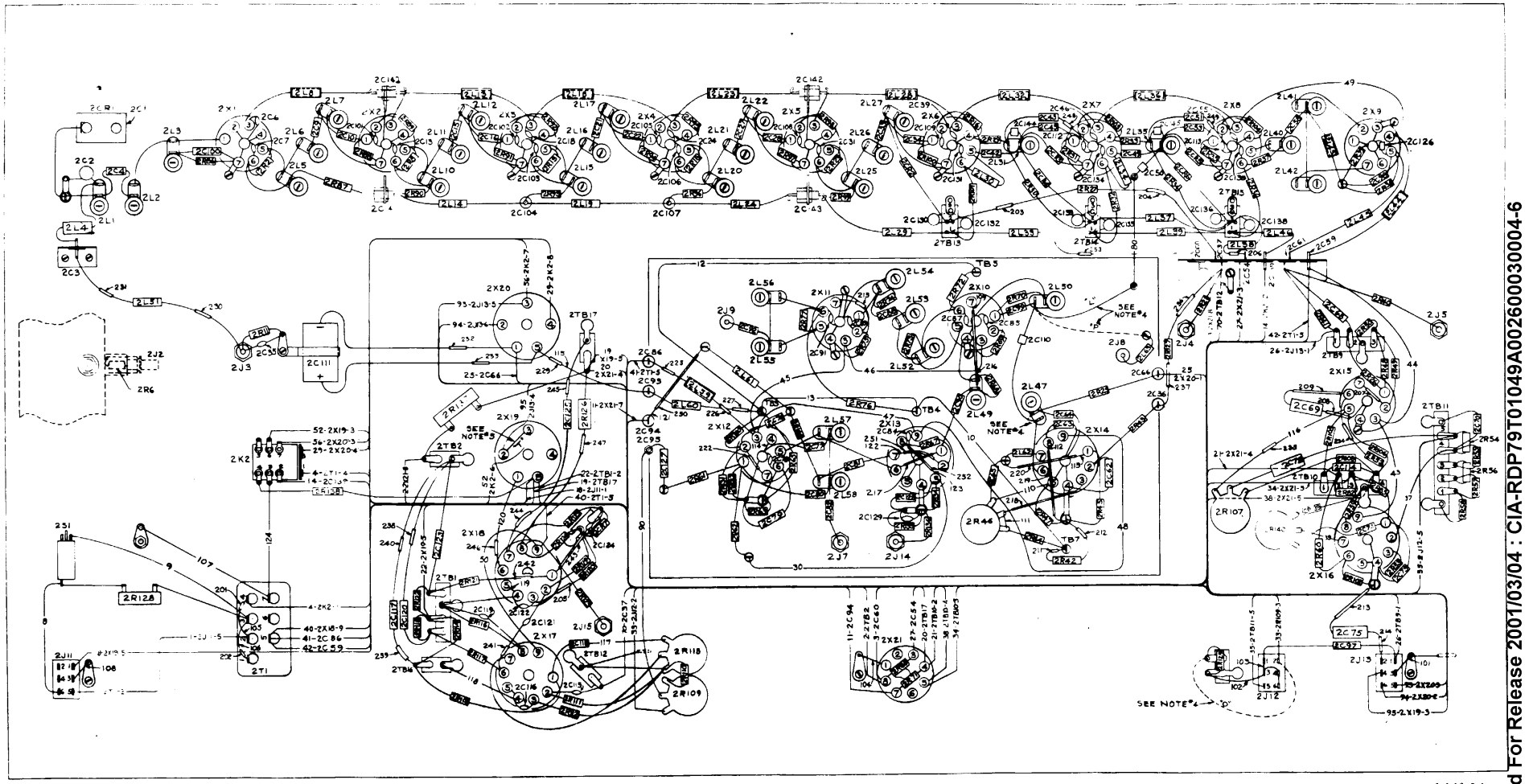
*2 CONNECTION "T" (2R3-2 TO 2K3-3) IS OMITTED WHEN RECEIVER IS USED IN A SYSTEM WITH STANDBY EQUIPMENT.

*3 LEGEND OF SIGNAL DEPENDENT VOLTAGES - UPPER VALUE IS FOR NO SIGNAL - LOWER IS FOR HIGH SIGNAL EXCEPT IN 2V18 UPPER VALUE IS FOR LITTLE OR NO SIGNAL - LOWER VALUE IS FOR 2V1 PULLED.

*4 - ADD LEADS "O" & "P", DISCONNECT LEAD "L" AT 2C55 & SHORT 2L47 WHEN RECEIVER IS USED IN TERMINAL STATION.

(1) ALL CAPACITOR VALUES GIVEN IN MMF. AND ALL RESISTOR VALUES GIVEN IN OHMS UNLESS OTHERWISE SPECIFIED.

Figure RM-8—Receiver/Modulator, MI-31102-A—Schematic Diagram



WIRE TABLE			A-8834408-502		
WIRE NOS. (INCLUSIVE)	DESCRIPTION COLOR AND CONDUCTOR		PS NO. OR DRAWING NO.	PTS LIST ITEM NO.	WIRE NOS. NOT USED
1 TO 4	WHT-BLUE	7X.010	PS724-1	89	
5 TO 14	WHITE			90	
15 TO 22	WHT-RED			91	
23 TO 30	WHT-YEL			92	28
33 TO 39	WHT-GRN	7X.010	PS724-1	93	36
40 TO 50	WHT-BRN/GRN	14X.010	PS724-9	94	
52	WHT-GRN/BLK	7X.010	PS724-1	76	
56	WHT-BLK	7X.010	PS724-1	78	
70	WHITE	SHIELDED WIRE	8554475-1	84	
80	BUS WIRE	(INSULATED)	8536088-1	96	
90	RF CABLE	RG 58A/U	99288-2	87	
93	WHITE	3 CONDUCTOR SHIELDED CABLE	460202-502	98	
94	WHT-BLUE				
95	WHT-YEL.				
101 TO 104	TINNED COPPER WIRE	.032 DIA.	PS105	85	
105 TO 107	TINNED COPPER WIRE	.050 DIA.	PS105	79	
108 TO 184	TINNED COPPER WIRE	.032 DIA.	PS105	85	
201 & 202	BLK. INS. TUBING	.066 I.D.	PS722-6	81	
203 TO 253	BLK. INS. TUBING	.039 I.D.	PS732-4	82	221, 243, 244, 245, 246

NOTES:-

1- DESIGNATION IN WIRES ARE WIRE NUMBERS AND THEIR DESTINATIONS.

2- SOLDER ALL ELECTRICAL CONNECTIONS USING ITEM 88. ALL WIRING TO BE IN ACCORDANCE WITH RCA STANDARD PRACTICE.

3- CABLE AND THEN LACE WIRES, WHERE NECESSARY, USING LACING CORD, ITEM 80.

4- WHEN RECEIVER IS USED IN TERMINAL STATION ADD "G" & "J" LEADS, DISCONNECT LEAD "L" AT 2C99 & SHORT 2L47.

5- CONNECTION "T" (2X19-2 TO 2X19-3) IS OMITTED WHEN RECEIVER IS USED IN A SYSTEM WITH STANDBY EQUIPMENT.

Figure RM-9—Receiver/Modulator, MI-31102-A—Connection Diagram

K

MICROWAVE COMMUNICATION EQUIPMENT

Transmitter MI-31132-2A

- TECHNICAL DATA
- DESCRIPTION
- INITIAL ADJUSTMENT
- MAINTENANCE
- REPLACEMENT PARTS

RADIO CORPORATION OF AMERICA
COMMERCIAL ELECTRONIC PRODUCTS, CAMDEN, N. J.

Printed In U.S.A.
DU 567

IB-33226-2

Approved For Release 2001/03/04 : CIA-RDP79T01049A002600030004-6

TECHNICAL DATA

Power Input:

a. Fil. Heaters and Blower: 95 watts at 115 volts—50/60 cycle ac.

b. Plate Supply: 65 milliamps at 250 v dc
300 milliamps at 500 v dc

Frequency Range

2450-2700 megacycles

Modulated Signal Input

70 megacycle FM Signal from the receiver/modulator unit

R-F Bandwidth

8 mc

Peak Carrier Deviation

±1.5 megacycles

Transmitter Power Output

±1.5 watts

Crystal

Symbol	*Type*	*Function*
1CR1	1N21B	RF Rectifier
1CR2	1N48	RF Rectifier

Tube Complement

Symbol	*Type*	*Function*
1V1	12AT7	DC Amplifier
1V2	*2C39B	Local Oscillator
1V3	*2C39B	Transmitter Mixer
1V4	*2C39B	RF Amplifier
1V5	6CL6	70 mc i-f Amplifier
1V6	2E26	70 mc i-f Amplifier

*Use RCA Stock No. 207832A only.

Transistor Complement

Symbol	*Type*	*Function*
1Q1	2N35	Current Regulator Control
1Q2	2N156	Current Regulator

Fuse Complement

Symbol	*Type*	*Function*
1F1	MJB 1/32 amp	Arc Indicator
1F2	MJB 1/32 amp	Arc Indicator
1F3	MJB 1/32 amp	Arc Indicator

Weight and Dimensions

Weight: 25 lbs.
Height: 10½"
Depth back of panel: (6" plus 1" allowance for air passage. 11" with air filter)
Depth front of panel: 4"
Width: 19" Rack Mounting

DESCRIPTION

This Transmitter Unit is designed for installation in either a standard 19" open rack or cabinet and is used in both terminal and repeater stations. It provides a frequency modulated r-f output in the frequency range of 2450 to 2700 mc.

The transmitter unit contains the equipment to generate and amplify the microwave carrier. The oscillator frequency is determined by tuning resonant cavity 1Z1A by means of the top left tuning screw. (This and the three other cavity tuning screws are located on the cavity assembly mounted on the front panel.) This frequency is coupled directly to the mixer cathode resonant cavity 1Z1B which is tuned by the lower left tuning screw. The oscillator frequency is mixed with the 70 mc carrier from the modulator section of the receiver/modulator unit. This 70 mc frequency modulated signal is injected into the cathode circuit of mixer tube 1V3. The resultant frequency, the sum or difference in accordance with the system plan, is fed thru mixer anode tuning cavity 1Z1C to the r-f amplifier 1V4. 1Z1C is tuned to the output frequency of the mixer stage by the upper right cavity tuning screw. The r-f amplifier stage is tuned to the same frequency as the mixer output. This tuning is done in resonant cavity 1Z1D by the lower right cavity tuning screw. (All cavity tuning screws are turned out for an increase in frequency.)

The plate tuning cavity 1Z1D of the r-f amplifier contains three pickup devices. The one connected to jack 1J2 absorbs a comparison sample for the terminal AFC unit. A loop transfers to 1J3 the r-f energy for the antenna. A slot is used to obtain energy to operate r-f monitor 1M2, the combination output meter and fault relay.

Seventy mc amplifier stages 1V5 and 1V6 amplify the 70 mc signal from the receiver/modulator to raise it to the proper amplitude before injection into the transmitter mixer circuit.

R-f monitor 1M2 is an r-f output indicating meter which also acts as the transmitter fault indicating device. The r-f energy for operating 1M2 is rectified by crystal 1N21B in cavity 1Z1D. MONITOR ADJUST 1R14 controls the amount of current flowing through 1M2 to keep the meter pointer on scale. When the output of r-f amplifier 1V4 drops to a certain predetermined value a circuit is closed inside 1M2 which energizes a transmitter fault reporting

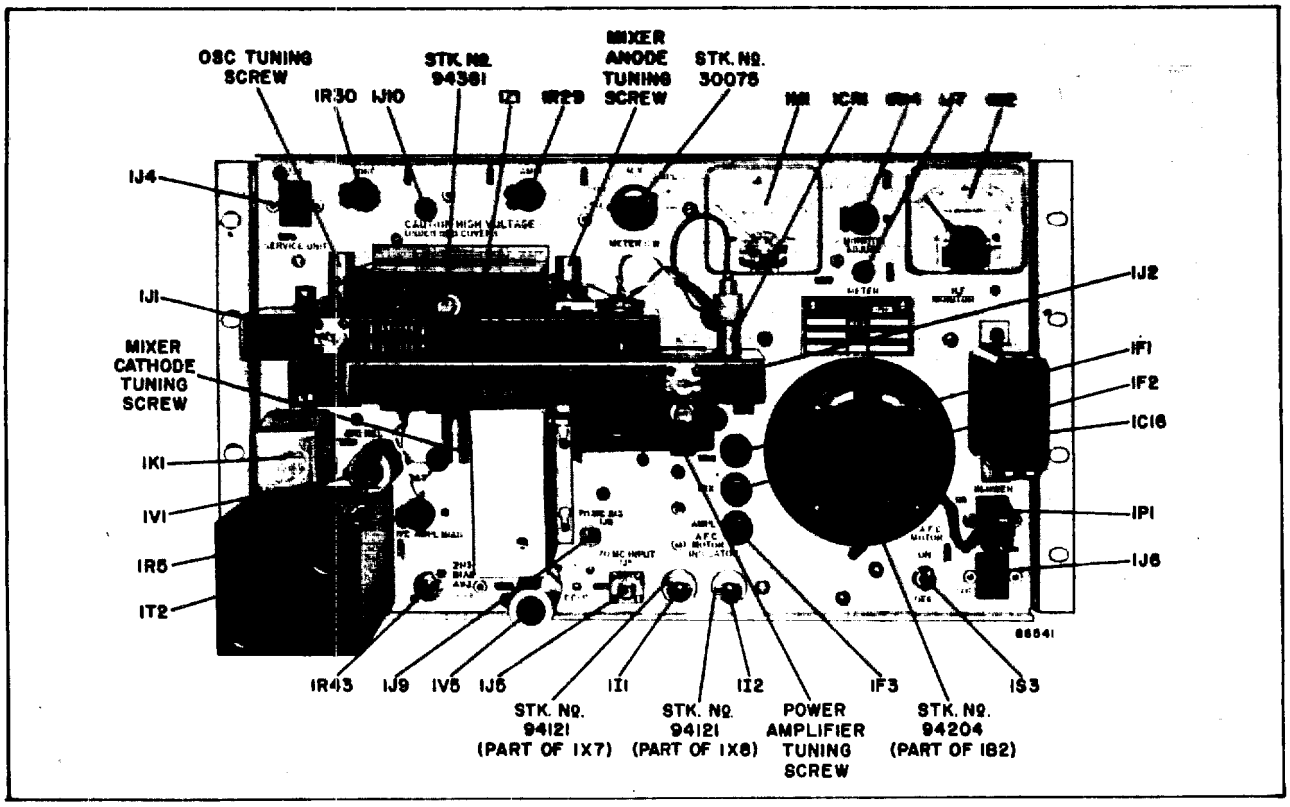


Figure T-1—Transmitter—Front View

relay in the service unit. The value at which the 1M2 relay reports a fault is indicated by the red pointer which can be set manually by a control knob on the front of 1M2.

DC amplifier 1V1, relay 1K1 and AFC motor 1B1 and associated circuits constitute the transmitter oscillator frequency control section. The following is the sequence of events that cause this equipment to function: A portion of the transmitter local oscillator output is coupled by a cable, attached to jack 1J1, to the receiver r-f mixer in the receiver/modulator unit. The transmitter oscillator frequency and the received microwave frequency determines the receiver 30 mc i-f. If the transmitter local oscillator drifts the resultant change in the receiver i-f causes a dc component to appear in the receiver 30 mc discriminator output. This dc is carried through the service unit to the transmitter jack 1J4 of the transmitter. From terminal 1 of jack 1J4 it is applied to the control grid of the 1-2-3 section of dc amplifier 12AT7 (1V1).

When the transmitter operates on the sideband above the L.O. (local oscillator) frequency, the connections to motor 1B1 are as shown in figures T-4 and T-5. (Motor 1B1 is actually two motors mounted on a single shaft. The F and B terminals shown on the schematic are the power connections to the "front" (F) and "back" (B) motors of 1B1. The "front" motor refers to the one nearest the panel.) Contact 7 of relay 1K1 is connected to the F terminal of 1B1 and contact 4 of 1K1 is connected to the B terminal of 1B1. If the receiver i-f increases for any reason, a positive dc voltage at 1V1-2 from the receiver discriminator will cause relay 1K1 to function so that 1B1 runs in a counterclockwise direction as indicated by the lighting of the + (1I2) lamp. This will turn the tuning loop in cavity 1Z1A to increase the L.O. frequency so that the receiver i-f is again 30 mc. A decrease of receiver i-f causes a negative dc voltage at 1V1-2 which will move the tuning loop in a clockwise direction, as indicated by the lighting of the (1I1) lamp, and decrease the L.O. frequency so that the receiver i-f is again 30 mc.

For lower sideband transmitter operation the connections to 1B1 are: contact 7 of relay 1K1 is connected to the B terminal of 1B1 and contact 4 of 1K1 is connected to the F terminal of 1B1. When 1B1 is connected in this manner a positive dc voltage at 1V1-2, caused by a receiver i-f increase, will cause the 1Z1A tuning loop to turn in a clockwise

direction and light the + (1I2) lamp. This will decrease the L.O. frequency until the receiver i-f is again 30 mc. A negative voltage at 1V1-2 caused by a receiver i-f decrease will cause the 1Z1A tuning loop to turn in a counterclockwise direction and light the — (1I1) lamp. This will increase the L.O. frequency until the receiver i-f is again 30 mc. The dc amplifier bias control 1R5 is adjusted so that when the receiver discriminator dc output is at zero voltage the AFC motor 1B1 stops running.

In order to prevent the AFC motor 1B1 from moving the tuning loop out of position during initial installation or when servicing the station equipment, an AFC motor disabling switch has been provided. With the AFC motor switch 1S3 open (OFF) the 115 v ac to 1B1 is disconnected.

Meter Switch 1S1A in conjunction with test meter 1M1 supplies a means of making the following measurements: On the 250 and 500 positions of 1S1A, meter 1M1 registers the two B+ voltages from the power supply. On the OSC, MIX and AMPL positions of 1S1A, 1M1 measures the cathode current of the oscillator 1V2, mixer 1V3, and RF amplifier 1V4 respectively. The + and — positions of 1S1A are used when positive and negative external voltage readings are made in this and other units by means of a test lead.

The transmitter oscillator, mixer and r-f amplifier tubes are cooled by blower 1B2 and if for any reason the blower should stop, the air operated switch 1S2 breaks the ac power to their filament transformer to prevent these tubes from overheating.

The plate circuit of tubes 1V2, 1V3 and 1V4 each contain a series combination of a $\frac{1}{32}$ amp. fuse and 150 ohm resistor in parallel with the 50 ohm damping resistor. Should arc-over occur in any of these tubes, evidence of this will be indicated by a blown 5F16 fuse in the power supply. The faulty tube may readily be detected by checking each of the arc indicating fuses 1F1 (OSC), 1F2 (MIXER) and 1F3 (AMPL.).

The cathode circuit of oscillator 1V2 contains a current regulating circuit that prevents the cathode current of 1V2 from varying greatly from the value set by 1R43.

CONTROLS

a. The Local Oscillator Tuning Screw (Upper left) of cavity 1Z1A varies the resonant frequency of the plate circuit cavity and so determines the frequency of the oscillator. (Turning the screw out increases the resonant frequency of the cavity. This applies to all four of the transmitter cavity tuning screws.)

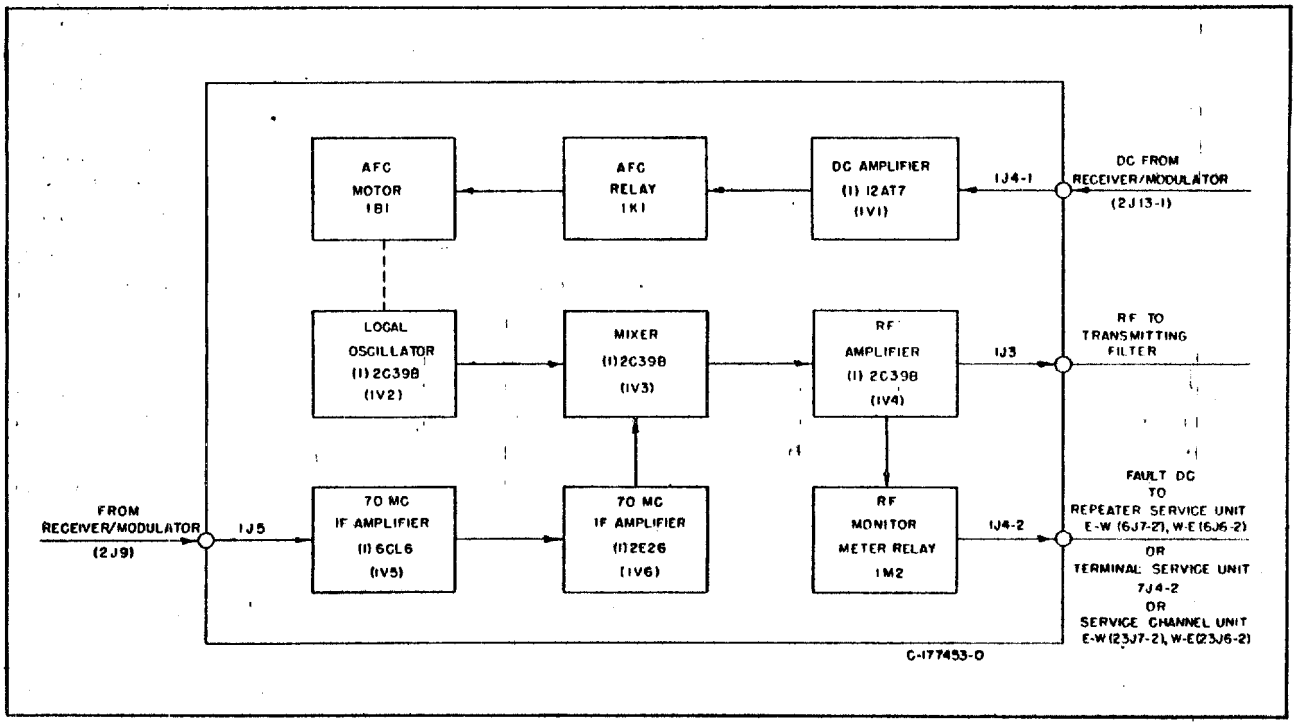


Figure T-2—Transmitter—Block Diagram

b. The Local Oscillator Cathode Tuning Screw (Lower left) of cavity 1Z1B varies the resonant frequency of the cathode cavity of the local oscillator and mixer cathode circuits. This tuning control has only a negligible effect on the oscillator frequency.

c. The Mixer Plate Tuning Screw (Upper right) of cavity 1Z1C varies the resonant frequency of the mixer tuning cavity. It is tuned either to the local oscillator frequency plus the 70 mc i-f carrier or to the local oscillator frequency minus the 70 mc i-f carrier in accordance with the system plan.

d. The RF Amplifier Tuning Screw (Lower right) of the cavity 1Z1D varies the resonant frequency of the plate tuning cavity. It is tuned to the mixer output frequency.

e. The OSC control (1R30) is a screwdriver adjusting potentiometer which adjusts the voltage across transistor 1Q2.

f. The AMPL control (1R29) is a screwdriver adjusted potentiometer which controls the cathode current of the r-f amplifier tube 1V4 by varying its cathode bias.

g. The MONITOR ADJUST control (1R14) is a screwdriver adjusted potentiometer that controls the amount of rectified r-f output from the r-f amplifier plate cavity which flows thru RF MONITOR 1M2. It is set so that the indicator of 1M2 remains on scale. This control is adjusted in conjunction with the setting of the red pointer on RF MONITOR 1M2.

h. The METER SW (1S1) allows various current and voltage readings of the transmitter and associated units to be observed on test meter 1M1.

Position 250 measures 250 v dc B+ from the power supply. (1000 volts full scale)

Position 500 measures 500 v dc B+ from the power supply. (1000 volts full scale)

Position OSC measures the cathode current of r-f oscillator 1V2. (200 milliamps full scale)

Position MIX measures the cathode current of mixer 1V3. (200 milliamps full scale)

Position AMPL measures the cathode current of r-f amplifier 1V4. (200 milliamps full scale)

*Position + measures positive voltages. (200 microamps full scale)

*Position — measures negative voltages (200 microamps full scale)

* From test points in this and other units by means of a test lead connected to the METER jack.

i. The DC AMPL BIAS control (1R5) varies the cathode bias of the 6-7-8 section of dc amplifier 1V1, the AFC relay control tube.

j. The Test Meter (1M1) (to the right of the meter switch) is used in conjunction with meter switch 1S1 to measure various circuit values in the transmitter unit and, by means of a plug-in test lead, to make current measurements in the other units.

k. METER pinjack (1J7) is the test lead connection when test meter 1M1 is used to measure voltage and current values in associated units.

l. The RF MONITOR r-f meter and relay (1M2), a combination r-f output meter and fault relay, gives a relative indication of r-f carrier output and functions as a fault reporting relay when the r-f output reaches a predetermined low value.

m. The L.O. (local oscillator) coaxial cable terminal (1J1) is used for supplying a portion of the local oscillator energy to the receiver r-f mixer stage.

n. The A.F.C. coaxial cable terminal (1J2) is used for transferring a portion of the transmitter output signal to the AFC mixer in the terminal AFC unit. Only used for terminal stations.

o. The 70 MC INPUT coaxial cable terminal (1J5) is the input connection for the coaxial cable carrying the 70 mc i-f signal from the receiver/-modulator.

p. The A.F.C. MOTOR INDICATOR (lamps 1I1 and 1I2) show when the AFC motor is running and in which direction. When the motor is correcting the local oscillator frequency, one of the lamps is lit and when the frequency correction is complete the lamp is extinguished.

q. The A.F.C. MOTOR SWITCH 1S3 is used for opening the 115 v ac line to AFC motor 1B1 to disable it during installation or servicing.

r. The 70 MC INPUT signal jack 1J9 is used for checking the 70 mc signal input level from the receiver/modulator.

s. The AFC LOOP INDICATOR shows the position of the AFC tuning loop in the local oscillator cavity. The pointer, when moved, changes the angle of the loop in the cavity. When the pointer is at the 0 position, the loop is at approximately 45° from the vertical, the correct position of the loop in the cavity.

t. The 2N35 BIAS ADJ. potentiometer (1R43) adjusts the bias of transistor 1Q1 which controls the oscillator 1V2 cathode current.

u. The Test Point (1J10) is provided for connecting meter 1M1 across the oscillator 1V2 cathode circuit when peaking the oscillator.

INITIAL ADJUSTMENT

The following is the procedure for tuning MM-26A Transmitters (MI-31132-2A) containing the new oscillator cathode current regulator circuit. Substitute this procedure for the transmitter tuning in the system book when the system tuning instructions do not specifically provide instructions titled *"Oscillator Tuning MM-26A"*.

Oscillator Tuning

Set the OSC control (1R30) to minimum resistance (fully clockwise and the 2N35 BIAS ADJ. control (1R43) one quarter turn from its full counterclockwise position. Place the meter switch (1S1) on the "+" position and connect one end of the test lead to meter pin jack 1J7 and the other to pin jack 1J10. Turn "on" the 500 v switch of the power supply and after warmup, turn the oscillator tuning plug (lower left) for maximum meter tuning indication. This meter indication is not a measurement of the current flow in the cathode circuit (oscillator activity) but is used strictly as a tuning indication. If an indication of over 80 is obtained, adjust the OSC control 1R30 to reduce the reading to 80.

If the cathode current does not change when turning the cathode tuning screw, the tube is not oscillating. If this should happen, turn "off" the LINE switch of the power supply and remove the 2N35 transistor from its socket. Turn "on" the power supply LINE switch and measure the voltage at terminal 2 of the current regulator assembly with a Voltohmyst or equivalent. If the reading is not 1.3 v dc, adjust it to this value with the 2N35 BIAS ADJ. control (1R34). Before reinserting the transistor into its socket turn "off" the LINE switch of the power supply. Return the 2N35 transistor to its socket and turn "on" the power supply.

CAUTION: The transistor will be damaged if it is removed from or inserted into its socket while the 250 v dc voltage is being supplied to the transmitter unit. Do not remove or insert the transistors in the above procedure without first removing the dc voltage from the unit. This precaution must be strictly observed.

Turn the oscillator tuning plug (lower left) for maximum meter tuning indication. If an indication of over 80 is obtained, adjust the OSC control 1R30 to reduce the reading to 80.

Turn the meter selector to the OSC position and adjust the 2N35 BIAS ADJ. control for a meter reading of 70 ma. The reading obtained in this measurement is the actual cathode current of the oscillator stage. Return the meter selector to the "+" position and readjust the oscillator tuning current to 80.

MAINTENANCE

General Notes

If the transmitter power output is decreasing the following notes may facilitate isolating the difficulty:

a. First, check the 70 mc drive to the transmitter mixer by turning off the 500 volts supply. The "MIX" reading should be greater than 35 ma. (The 40 ma figure listed in the INITIAL ADJUSTMENT section of the system instructions is the expected minimum for new tubes.) The reading obtained on 1M1 when 1J9 is connected to 1J7 should be at least 30μa.

If the "MIX" reading is below 35 ma check the 70 mc signal voltage input from the receiver/modulator. The 30 μa reading at 1J9 is equivalent to 1 volt at 1V5-3. If this value is less than 1 volt the receiver/modulator is not delivering enough drive to the transmitter and the correction will have to be made in the receiver/modulator unit. If the input to 1V5 is sufficient, check both 1V5 and 1V6 tubes and replace if necessary.

b. Second, check the quality of the oscillator tube by noting how much its cathode current increases as the tube changes from a non-oscillating to an oscillating condition. (The bottom oscillator slug can be detuned to stop oscillation.) The current should increase by approximately 3:1 for a good tube. If the increase is less than 1.5:1 the tube should be replaced.

c. If the oscillator is supplying adequate drive to the mixer tube cathode current (meter switch at MIX) should drop to roughly 50% of the normal value when the 70 mc cable is removed. If this decrease is of the order of only 10%, a point of marginal operation has been reached. The mixer cathode current is determined in part by the oscillator drive. If the mixer cathode current exceeds 125 ma, the oscillator cathode current should be reduced.

d. A poor 2C39B amplifier is frequently revealed by an inability to get adequate cathode current, with sufficient drive from the mixer, as the cathode vari-

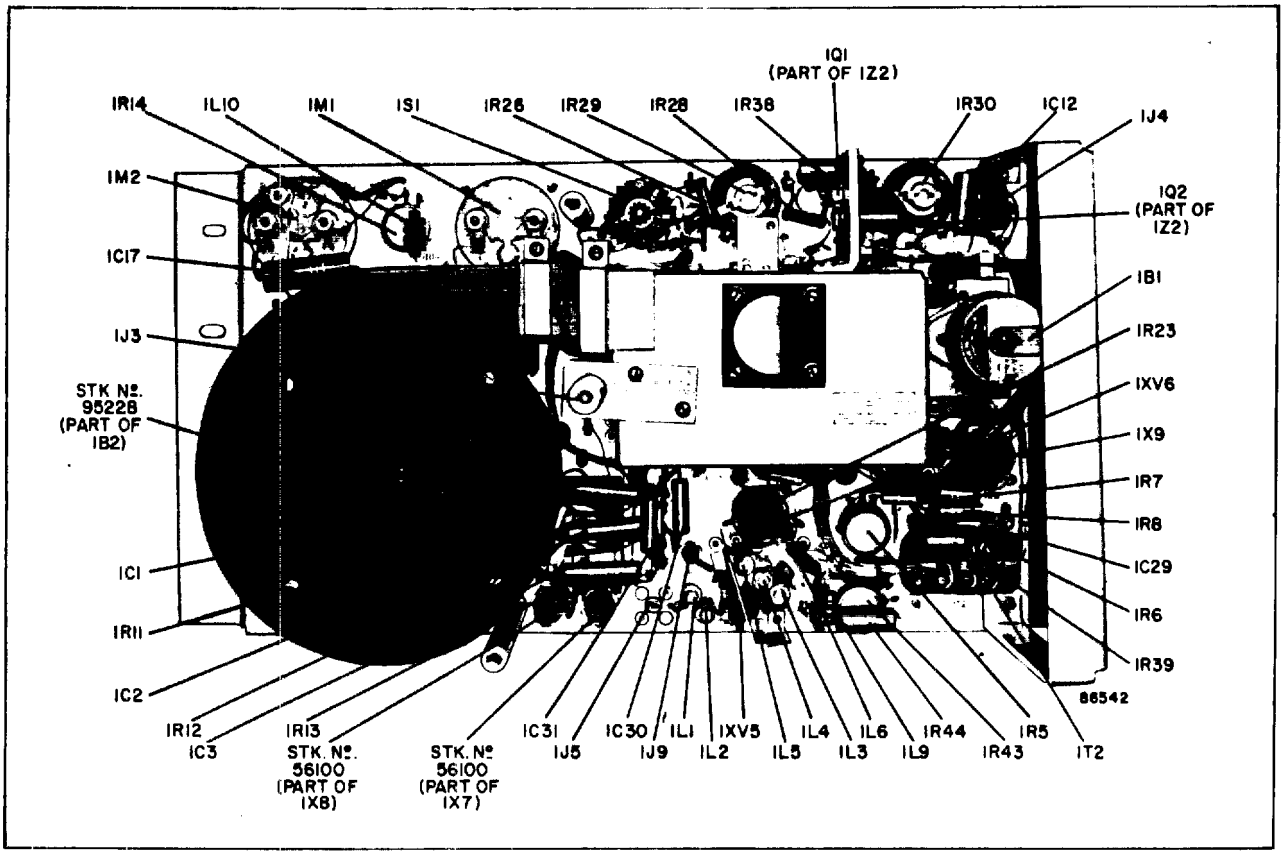


Figure T-3—Transmitter—Rear View

able resistor (1R29) is decreased. When less than 75 ma of "AMPL" cathode current is obtained with 1R29 set at minimum the amplifier tube should probably be replaced.

e. If the transmitter fails completely it may be caused by a defective 2C39B electron tube or the breakdown of capacitors 1C19, 1C23 or 1C26. If one of these capacitors is shorted due to dust and moisture or if certain elements of tubes 1V2, 1V3 or 1V4 becomes shorted, then the 500 v B+ power is short circuited and fuse 5F16 in the power supply will be blown. The tube circuit at fault can readily be found by noting which of the arc indicating fuses 1F1, 1F2 or 1F3 is blown.

f. Variable resistor 1R14 "MONITOR ADJUST" is used to adjust the operating point of meter relay 1M2. A suggested setting of 1R14 is that which will give a 1M2 reading of 150 μa. Set the red hand of 1M2 at the meter reading below which the transmitter output should not fall. Meter/Relay 1M2 will report a transmitter fault to the service unit when the transmitter output falls to this value.

g. Both the transmitter AFC motor and the blower motor have lifetime lubricated bearings. The grease sealed bearings of the blower section of the blower-motor should be inspected periodically and replaced with new bearings when necessary. The normal life of the bearings is between three and four years.

h. If the blower motor runs but the tube filaments do not burn, check the operation of the air operated switch 1S2.

Transmitter AFC Circuit

As d-c amplifier tube 1V1 ages, D.C. AMPL. BIAS potentiometer 1R5 must be readjusted to keep the i-f frequency of the receiver/modulator centered at 30 mc. When the range of adjustment provided by 1R5 is no longer adequate to center the i-f, 1V1 must be replaced.

Transmitter AFC Circuit Test

If the transmitter AFC circuit fails to respond to the dc correction signals from the discriminator of the receiver/modulator, the d-c amplifier may be the cause.

Check the sensitivity of the d-c amplifier 1V1 as follows (with the AFC motor 1B1 connected for upper side band operation as shown in Figure T-4):

1. Apply + .15 volts to pin 1 of jack 1J4 and ground. This voltage should cause the AFC motor indicator light, marked +, to light.

2. Apply − .15 volts to pin 1 of jack 1J4 and ground. This voltage should cause the AFC motor indicator light, marked −, to light.

3. Check the action of the clutch by moving the loop indicator by hand.

70 MC Circuit Alignment

NOTE: The test items specified in this alignment procedure refer to the test equipment items listed in the test equipment tables of the system instructions.

a. Apply the output of the 70 mc sweep generator (test item 18), with markers, to 1V6-5. (Tube shields of 2E26 and 6CL6 and the shields of transformer 1T1 must be in place.)

b. Connect the CRO (test item 4) to the cathode of 1V3 (2C39-B mixer tube).

c. Turn on the 115 volt a-c and 250 volt d-c supplies.

d. Adjust 1T1 and 1C33 for correct alignment. The response is that of an over-coupled double-tuned circuit with peaks approximately 12 megacycles apart.

NOTE: Should it be impossible to align this stage the reason is, most likely, that either of the two circuits is not tuned to 70 mc ± 1 mc. The resonant frequencies of the two circuits are easily checked with test item 12.

e. Connect the CRO to 1V6-3, connect the sweep generator to 1V5-2, and adjust 1L3, 1L4, and 1L5 for the correct response. The response curve is nearly flat with 3 db points 10 mc apart.

f. Connect the CRO to 1V5-8, connect the sweep generator to Pin No. 1 of the 70 mc amplifier 2V11 and connect the 70 MC OUTPUT jack 2J9 to the 70 MC INPUT jack 1J5 of the transmitter and adjust 1L1 and 1L2 for the correct response.

g. Connect the CRO to the cathode of 1V3 to check the overall response.

IMPORTANT

If the repair of cavity 1Z1 is required and if the removal of the mounting assemblies of electron tubes 1V2, 1V3 and 1V4 is necessary it is important that these parts be very carefully positioned upon reassembly. If the opening in the plates of these assemblies are not in line the tubes are likely to be broken when inserted. For proper installation of these tube mounting assemblies use the following instructions:

1. Install the ring assembly in the holes of the partition between the two cavity sections and tighten the screws.

TYPICAL TRANSMITTER VOLTAGES AND METER READINGS

The following are approximate voltages existing between the indicated tube pins and ground as measured with a voltohmyst with 100,000 ohms in series with the measuring probe. All voltages are dc unless otherwise noted.

Tube	*Type*	*Function*	*Pin 1*	*Pin 2*	*Pin 3*	*Pin 4*	*Pin 5*	*Pin 6*	*Pin 7*	*Pin 8*	*Pin 9*
1V1	12AT7	DC ampl.	90	0	1.8	0	0	250	90	92	6.3 ac
1V5	6CL6	70 mc. ampl.	2.3	0	117	0	6.3 ac	228	2.3	117	—
1V6	2E26	70 mc. ampl.	15	0	185	15	0	15	6.3 ac	—	Plate cap 250

The following are typical readings of test meter 1M1 for the various positions of "METER SW" 1S1:

250v— 50 μa
500v—100 μa } Meter connected as a voltmeter of roughly 100 volt full scale reading
OSC—70 ma
MIX.—100 ma max., 60 ma min.
AMPL.—100 ma max.
+ } In these positions the meter is connected to an external probe for use in testing other MM-26A
— } unit quantities

2. Install the assembly that holds the cathode and filament terminals (small end) of the tubes but leave the mounting screws very loose.

3. Install the assembly that holds the plate (large end) terminal of the tubes but leave the mounting screws loose.

4. Insert a 2C39-B tube allowing all parts to center about the tube. Tighten all screws with the tube in place. Remove the tube.

The installation of tubes 1V2, 1V3 and 1V4 may now be done without danger of damage to the tubes.

REPLACEMENT PARTS LIST

Symbol No.	*Description*	*Drawing No.*	*Stock No.*
1B1	Motor, timing motor and gear units (afc drive) 110 v., 60 cy.	8832092-1	94203
1B2	Blower, 115/230 v., 50/60 cy., 3300 rpm, (not stocked complete, see parts below)	741276-4	
	Motor: for blower 1B2, 115/230 v., 50/60 cy., 3300 rpm, (pt. of 1B2)	741276-2	94204
	Bearing: ball, for blower motor, (pt. of 1B2)	8830675-2	95228
1C1 to 1C3	Capacitor, fixed, paper, 0.01 mf., ± 10%, 1000 v.	735715-363	73565
1C4	Capacitor, fixed, mica, 1000 mmf., ± 10%, 500 v.	984002-121	94189
1C5 to 1C8	Capacitor, fixed ceramic, 820 mmf., + 100 —0%, 500 v.	449696-1	94190
1C9	Capacitor, fixed, ceramic, 220 mmf., ± 20%, 500 v.	735717-633	95319
1C10, 1C11	Capacitor, fixed, ceramic, 820 mmf., + 100 —0%, 500 v. Same as 1C5	449696-1	94190
1C12	Capacitor, fixed, paper, 0.1 mf., ± 20%, 200 v.	735715-25	73784
1C13 to 1C15	Capacitor, fixed, ceramic, feed thru type, 1000 mmf., ± 80 —20%, 500 v.	8828585-3	203760
1C16	Capacitor, fixed, paper, 4 mf., 330 v. ac, for blower motor	990195-5	208503
1C17	Capacitor, fixed, paper, 0.47 mf., ± 20%, 200 v.	735715-33	73787
1C18 to 1C27	Part of 1Z1.		
1C28	Capacitor, fixed, ceramic, 820 mmf., + 100 —0%, 500 v. Same as 1C5	449696-1	94190
1C29	Capacitor, fixed, paper, 0.1 mf., ± 10%, 400 v.	735715-175	73551
1C30, 1C31	Capacitor, fixed, paper, 0.033 mf., ± 20%, 400 v.	735715-119	73552
1C32	Capacitor, fixed, ceramic, 22 mmf., ± 5%, 500 v.	984015-218	93716
1C33	Capacitor, variable, ceramic trimmer, 4.5/28 mmf.	8819214-1	203761
1C34	Capacitor, fixed, ceramic, 220 mmf., ± 20%, 500 v. Same as 1C9	735717-633	95319
1CR1	Rectifier, germanium diode 1N21B	1N21B	67876
1CR2	Rectifier, germanium diode 1N48	1N48	203954
1F1 to 1F3	Fuse, cartridge 1/32 amp., 250 v., 1" lg. x ¼" dia.	8851771-17	69417
1I1, 1I2	Lamp, neon, starting volts 65 v. ac, 90 v. dc, min bay base	872291-9	91749
1J1, 1J2	Connector, female, coaxial, chassis mounted, with ¼" lg. cavity loop (pt. of 1Z1)	456989-501	94248
1J3	Connector, female, coaxial, chassis mounted, with 7/32" lg. loop and teflon beads (r-f output)	460231-503	203972
1J4	Connector, male, 6 contact, chassis mounted	181494-3	28507
1J5	Connector, female, coaxial, chassis mounted	8845666-1	94205
1J6	Connector, male, 6 contact, chassis mounted. Same as 1J4	181494-3	28507
1J7	Connector, pin jack, for .080 dia. pin	742565-1	93678
1J8	Connector, female, 6 contact, chassis mounted	181494-4	18534
1J9, 1J10	Connector, pin jack, for .080 dia. pin. Same as 1J7	742565-1	93678
1K1	Relay, differential polarized, s.p., 3 pos., null seeking, coils each 3500 ohms, octal plug-in type	8834407-1	94206
1L1	Coil, adj. iron core, 3 turns of .0126 dia. wire on form 0.920 lg.	629132-522	94207
1L2	Coil, adj. iron core, 5 turns of .0126 dia. wire on form 0.920 lg.	629132-524	94208
1L3	Coil, adj. iron core, 11 turns of .0126 dia. wire on form 0.920 lg.	629132-517	94245
1L4	Coil, adj. iron core, 15 turns of .0126 dia. wire on form 0.920 lg.	629132-527	94239
1L5	Coil, adj. iron core, 6 turns of .0126 dia. wire on form 0.920 lg.	629132-520	94211
1L6	Reactor, iron core, 2.5 microhenry	8834424-501	94040
1L7	Reactor, r-f choke, 7.5 microhenry, 275 ma.	459688-76	205050
1L8	Part of 1Z1		
1L9	Reactor, r-f choke, 7.5 microhenry, 275 ma. Same as 1L7	459688-76	205050
1L10	Reactor, r-f choke, 2.5 millihenry, 50 ma.	8886161-6	98426
1L11	Reactor, r-f choke, 0.84 microhenry, 1000 ma.	8898641-2	57239
1M1	Meter, d-c 0-200 microamperes	456986-1	94213
1M2	Meter, d-c, special, 0-200 microamperes, with switch and contact locking winding, single contact low limit adjustable	8834409-1	94214
1P1	Connector, male, 6 contact, cable mounting type	181494-2	28454

Symbol No.	Description	Drawing No.	Stock No.
1Q1	Transistor		2N35
1Q2	Transistor, power	2N156	214396
1R1	Resistor, fixed, composition, 4.7 meg., ± 20%, ½ w.	82283-35	30931
1R2	Not used.		
1R3	Resistor, fixed, composition, 150 ohms, ± 5%, ½ w.	82283-139	502115
1R4	Resistor, fixed, composition, 180,000 ohms, ± 10%, ½ w.	82283-89	502418
1R5	Resistor, variable, composition, 5000 ohms, ± 10%, 2 w.	737829-30	94039
1R6	Resistor, fixed, composition, 6800 ohms, ± 10%, 2 w.	99126-72	522268
1R7, 1R8	Resistor, fixed, composition, 30,000 ohms, ± 5%, 2 w.	99126-194	522330
1R9	Resistor, fixed, composition, 120,000 ohms, ± 5%, 2 w.	99126-209	522412
1R10	Not used.		
1R11, to 1R13	Resistor, fixed, wire wound, 50 ohms, ± 10%, 10 w.	8825410-54	59282
1R14	Resistor, variable, composition, 50,000 ohms, ± 10%, 2 w.	737829-32	203068
1R15	Resistor, fixed, composition, 27,000 ohms, ± 5%, ½ w.	82283-193	502327
1R16	Resistor, fixed, composition, 1500 ohms, ± 10%, ½ w.	82283-64	502215
1R17	Resistor, fixed, composition, 100 ohms, ± 10%, ½ w.	82283-50	502110
1R18	Resistor, fixed, composition, 3300 ohms, ± 10%, ½ w.	82283-68	502233
1R19	Resistor, fixed, composition, 27,000 ohms, ± 10%, 1 w.	90496-79	512327
1R20	Resistor, fixed, composition, 1000 ohms, ± 20%, ½ w.	82283-13	502210
1R21	Resistor, fixed, composition, 1500 ohms, ± 10%, ½ w. Same as 1R16	82283-64	502215
1R22	Resistor, fixed, composition, 470 ohms, ± 10%, ½ w.	82283-58	502147
1R23	Resistor, fixed, composition, 47,000 ohms, ± 10%, 1 w.	90496-82	512347
1R24	Resistor, fixed, composition, 100 ohms, ± 10%, ½ w. Same as 1R17	82283-50	502110
1R25	Resistor, fixed, composition, 10,000 ohms, ± 10%, ½ w.	82283-74	502310
1R26 to 1R28	Resistor, fixed, wire wound, 0.66 ohms, ± 1%, 1 w., meter shunt	8871557-11	56327
1R29, 1R30	Resistor, variable, wire wound, 500 ohms, ± 10%, 25 w.	180639-8	95312
1R31	Not used.		
1R32	Resistor, fixed, composition, 4.7 meg., ± 5%, ½ w.	82283-247	30931
1R33	Resistor, fixed, composition, 100 ohms, ± 10%, ½ w. Same as 1R17	82283-50	502110
1R34	Resistor, fixed, composition, 4.7 meg., ± 5%, ½ w. Same as 1R32	82283-247	30931
1R35, 1R36	Resistor, fixed, composition, 270,000 ohms, ± 10%, ½ w.	82283-91	502427
1R37	Resistor, fixed, composition, 10,000 ohms, ± 10%, ½ w. Same as 1R25	82283-74	502310
1R38	Resistor, fixed, wire wound, 100 ohms, ± 5%, 5 w.	458572-26	94377
1R39	Resistor, fixed, wire wound, 0.38 ohms, ± 10%, 5 w.	458592-1	97911
1R40 to 1R42	Resistor, fixed, composition, 150 ohms, ± 10%, 1 w.	90496-52	512115
1R43	Resistor, variable, composition, 500 ohms, ± 10%, 2 w., (screw driver shaft)	458575-105	98221
1R44	Resistor, fixed, wire wound, 20,000 ohms, ± 5%, 5 w.	458575-89	53362
1R45	Resistor, fixed, composition, 10 ohms, ± 5%, 2 w., (pt. of 1Z2)	99126-111	522010
1R46	Resistor, fixed, composition, 560 ohms, ± 5%, ½ w., (pt. of 1Z2)	735730-153	502156
1R47	Resistor, fixed, composition, 100,000 ohms, ± 5%, ½ w., (pt. of 1Z2)	735730-207	502410
1R48	Resistor, fixed, composition, 15 ohms, ± 5%, 2 w., (pt. of 1Z2)	99126-115	522015
1S1	Switch, rotary, wafer, single section, single circuit, 7 position, non-shorting	458908-1	94193
1S2	Switch, rotary, snap action, s.p.s.t. normally open contacts, (air interlock)	449277-1	59479
1S3	Switch, toggle, s.p.s.t.	187454-2	48791
1T1	Transformer, r-f, adj. core, 70 mc.	8819222-501	203762
1T2	Transformer, filament	469743-1	207287
1TB13	Board, 10 terminal, not stocked complete, for parts see, 1R45, 1R46, 1R47, 1R48, 1XQ1	482616-501	
1V2, 1V3, 1V4	Tube, vacuum, u.h.f. power triode (2C39B)		207832A
1X1	Socket, tube, 9 pin min.	984055-2	94880
1X2 to 1X4	Part of 1Z1.		
1X5	Socket, tube, 9 pin min. Same as 1X1	984055-2	94880
1X6	Socket, tube, std. octal, natural phenolic	99391-1	68590
1X7, 1X8	Pilot Light Assembly	8834425-1	
"	Jewel, pilot light clear jewel only, less socket and lamp (pt. of 1X7, 1X8)	8834425-1	94121
"	Socket, pilot light socket only, less jewel and lamp (pt. of 1X7, 1X8)	8834425-1	56100
1X9	Socket, tube, std. octal, black phenolic	99100-3	68590
1X10	Not used.		
1X11 to 1X13	Holder, fuse, (for 1F1, 1F2, 1F3)	8813054-1	97912
1XQ1	Socket, transistor, for 2N35 (A-1 Socket)	8888533-8	101647
"	(B-1 Retainer)	8941074-1	

Symbol No.	*Description*	*Drawing No.*	*Stock No.*
1Z1	Cavity Assembly, transmitter, tuning range, 2450-2700 mc.	636644-502	213898
	Box Assembly, cavity box only, less tube sockets and tuning core assemblies	635966-501	213899
	Bushing, textolite, 0.499 O.D. × 0.470 I.D. × 0.160 lg., mixer capacitor insulating	8831010-1	94270
	Contact, beryllium copper, grid contact ring, less osc. loop, for 2C39-B tubes	8903740-501	207374
	Contact, beryllium copper, grid contact ring, less osc. loop, for 2C39-B tubes	8903740-502	207375
	Contact, beryllium copper, plate contact ring, for 2C39-B tubes	750302-501	203765
	Contact, beryllium copper, cathode contact ring, for 2C39-B tube	8903749-501	207376
	Contact, beryllium copper, filament contact stud, for 2C39-B tubes	8832042-2	207378
	Core, brass, # 5/8"-24 threaded type, 1 7/8" lg. overall, cavity tuning	8903730-1	207377
	Insulator, laminated phenolic, 7/8" O.D. × 0.116 I.D. × 1/16" thick, with 3/16" dia. off-set hole, filament contact insulating, for 2C39-A tubes	8831012-2	207379
	Nut, brass, knurled, 1"-32 inside thread, 3/4" I.D. opposite side 1 1/16" O.D. × 5/32", for mixer capacitor	8831011-1	94269
	Nut, brass, # 5/8"-24 hex., tuning core locking	874927-6	95395
	Washer, mica, 1/2" O.D. × 0.484 I.D. × .006 thick, filament contact insulating, for 2C39-B tubes	892950-3	203766
	Washer, spring, beryllium copper, 21/32" I.D. × 25/32" O.D. × .015 thick, tuning core locking	8903734-1	207380
1Z2	Current Regulator Assy., not stocked complete, for parts see 1R45, 1R46, 1R47, 1R48, 1TB13, 1XQ1, 1Q1, and the following parts	482618-501	
	Insulator, glass cloth, 0.283 O.D. × 0.253 I.D. × 0.170 lg.	8825609-18	214399
	Oil, silicone, 1 oz. bottle	899256-6	99761
	Washer, plastic, 0.56 O.D. × 0.250 I.D. × .002 thick	8864518-5	214397
	Washer, laminated phenolic, 0.62 O.D. × 0.257 I.D. × 0.093 thick	8864518-4	214398
	Miscellaneous		
	Boot, blower, wool gabardine, 2 31/32" dia. × 2" lg.	8832079-1	94385
	Coil, afc loop and shaft assembly	8813040-502	213901
	Connector, male, pin jack, cable mtg.	185290-1	93856
	Connector, tube cap, for 1V6	888550-1	207701
	Contact, 2C39 tube radiator plate contact, less lead	8819241-1	213900
	Cushion, afc, drive assembly mtg. rubber, 7/8" lg. × 1/4" × 3/16" with 1/16" wide × 1/8" deep channel, supplied in bulk piece 19" lg.	8833025-4	94784
	Insulator, textolite bead, 9/32" lg. × 0.447 O.D. × 0.254 I.D., (1CR1, 1C4 mtg.)	8834421-1	94382
	Knob, round, black bakelite, pointer type, for 1S1	712336-507	30075
	Lever, 1S2 switch activating lever and plate assy.	8832071-501	94383
	Screw, thumb, # 6-32 × 15/16" lg. overall, with 13/32" dia. × 3/8" lg. knurled hd., cover plate retaining	8831054-1	94381
	Shield, tube, 9 pin min., 1 15/16" lg.	8858642-3	56359
	Shield, tube, 7 pin min., 2 1/4" lg.	99369-3	57540
	Spring, helical, mtd. on plate, 1 5/16" sq., blower shock mtg., 2 req'd.	8834442-501	94387
	Strap, steel, 0.0179 thick × 11 1/8" lg. × 1/2" wide, blower boot clamping, 2 req'd.	8832080-1	94386

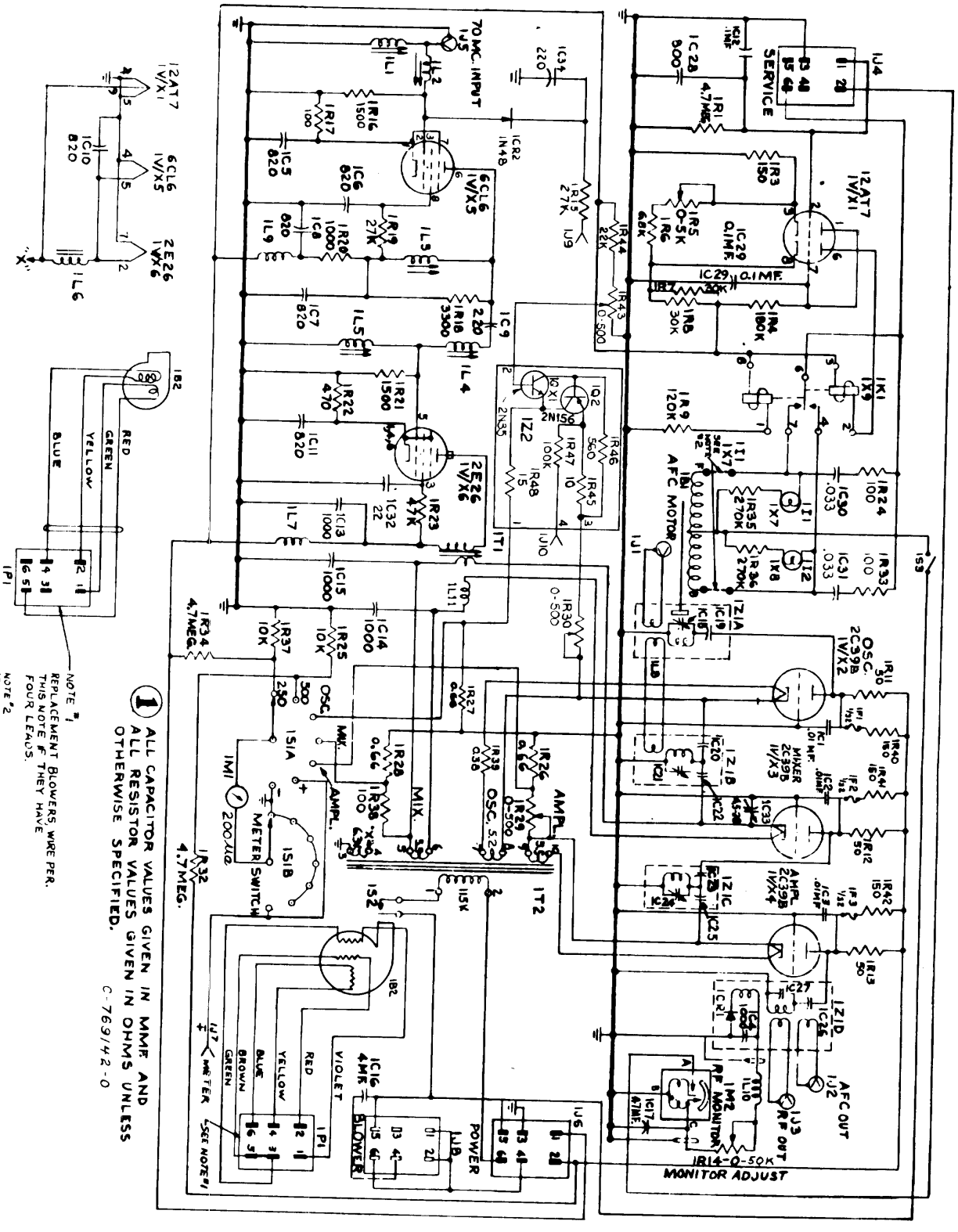
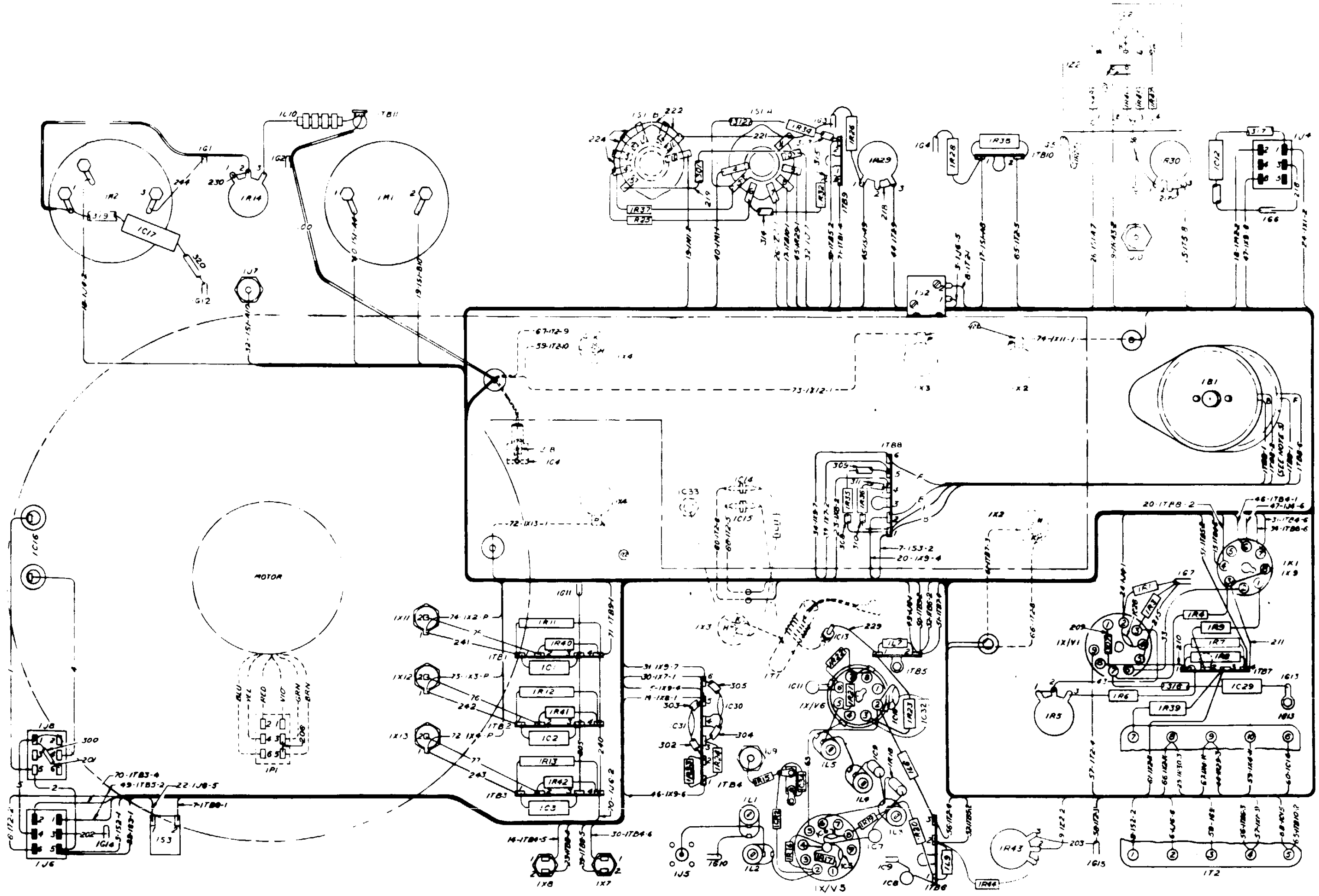


Figure T-4—Transmitter—Schematic Diagram



E-361732-0

NOTES
1. DESIGNATIONS IN WIRES ARE WIRE NUMBERS AND THEIR DESTINATIONS.
2. SOLDER ALL ELECTRICAL CONNECTIONS USING ITEM 98. ALL WIRING TO BE IN ACCORDANCE WITH R.C.A. STANDARD PRACTICE.
3. CABLE AND LACE WIRES WHERE NECESSARY USING ITEM 99
4. WIRE NUMBERS NOT USED ARE 204, 207, 208, 212, 213, 214, 220, 223, 225, 226, 227 & 228
5. 1B1 IS SHOWN CONNECTED FOR UPPER SIDEBAND OPERATION, FOR LOWER SIDEBAND OPERATION INTERCHANGE CONNETIONS FROM 1B1 TO 1TB8-6 AND 1TB8-2.
6. BLOWER ASSEMBLY IS OUTLINED BY PHANTOM LINE AT APPROXIMATE PHYSICAL LOCATION.
7. NUMBERS IN BALLOONS REFER TO LIST OF PARTS

WIRE TABLE			8918500-503		
WIRE NO. (INCLUSIVE)	DESCRIPTION COLOR &	CONDUCTOR	PS NUMBER OR DRAWING NUMBER	PARTS LIST ITEM NO.	WIRE NUMBERS NOT USED
1 TO 10	WHT	7/.010	PS-805-6	100,185	
14 TO 20	-BLK			101	
22 TO 26	-GRN			102	
30 TO 36	-BLU			103	
39 TO 40	-RED			104	
43 TO 47	-YEL	7/.010	PS-805-6	105	
49 TO 52	-RED	7/.0126	PS 805-7	106	
56 TO 63	-BRN/GRN	19/.010	PS 805-8	107	
66 TO 68	-BLU/RED	19/.010	PS 805-8	108	
70 TO 77	WHT-RED	16/.010	8827623-5	109	
100 TO 101	SHIELDED CABLE		8857890-7	110	
201 TO 230	TINNED COPPER WIRE	.032 DIA.	PS-105	96	SEE NOTE 4
240 TO 244	TINNED COPPER WIRE	.050 DIA.	PS-105	97	
300 TO 317, 319, 320	BLACK INS. TUBING	.042 I.D.	PS-8	93	
318	BLACK INS. TUBING	.166 I.D.	PS-8	92	

Figure T-5—Transmitter—Wiring Diagram

Approved For Release 2001/03/04 : CIA-RDP79T01049A002600030004-6

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MICROWAVE COMMUNICATION EQUIPMENT

Transmitter MI-31132-2C

- TECHNICAL DATA
- DESCRIPTION
- INITIAL ADJUSTMENT
- MAINTENANCE
- REPLACEMENT PARTS

RADIO CORPORATION OF AMERICA
COMMUNICATION PRODUCTS DEPARTMENT, CAMDEN, N. J.
PRINTED IN U.S.A.
DU-529
IB-33226-3

TECHNICAL DATA

Power Input:
a. Fil. Heaters and Blower: 95 watts at 115 volts—50/60 cycle ac.
b. Plate Supply: 65 milliamps at 250 v dc
300 milliamps at 825 v dc

Frequency Range
2450-2700 megacycles

Modulated Signal Input
70 megacycle FM Signal from the receiver/modulator unit

R-F Bandwidth
8 mc

Peak Carrier Deviation
±1.5 megacycles

Transmitter Power Output
1.5 watts

Crystal

Symbol	*Type*	*Function*
1CR1	1N21B	RF Rectifier
1CR2	1N48	RF Rectifier

Tube Complement

Symbol	*Type*	*Function*
1V1	12AT7	DC Amplifier
1V2	*2C39B	Local Oscillator
1V3	*2C39B	Transmitter Mixer
1V4	*2C39B	RF Amplifier
1V5	6CL6	70 mc i-f Amplifier
1V6	2E26	70 mc i-f Amplifier

*Use RCA Stock No. 207832A only.

Transistor Complement

Symbol	*Type*	*Function*
1Q1	2N339	Current Regulator Control
1Q2	2N158	Current Regulator

Weight and Dimensions
Weight: 25 lbs.
Height: 10½"
Depth back of panel: (6" plus 1" allowance for air passage. 11" with air filter)
Depth front of panel: 4"
Width: 19" Rack Mounting

DESCRIPTION

This Transmitter Unit is designed for installation in either a standard 19" open rack or cabinet and in used in both terminal and repeater stations. It provides a frequency modulated r-f output in the frequency range of 2450 to 2700 mc.

The transmitter unit contains the equipment to generate and amplify the microwave carrier. The oscillator frequency is determined by tuning resonant cavity 1Z1A by means of the top left tuning screw. (This and the three other cavity tuning screws are located on the cavity assembly mounted on the front panel.) This frequency is coupled directly to the mixer cathode resonant cavity 1Z1B which is tuned by the lower left tuning screw. The oscillator frequency is mixed with the 70 mc carrier from the modulator section of the receiver/modulator unit. This 70 mc frequency modulated signal is injected into the cathode circuit of mixer tube 1V3. The resultant frequency, the sum or difference in accordance with the system plan, is fed thru mixer anode tuning cavity 1Z1C to the r-f amplifier 1V4. 1Z1C is tuned to the output frequency of the mixer stage by the upper right cavity tuning screw. The r-f amplifier stage is tuned to the same frequency as the mixer output. This tuning is done in resonant cavity 1Z1D by the lower right cavity tuning screw. (All cavity tuning screws are turned out for an increase in frequency.)

The plate tuning cavity 1Z1D of the r-f amplifier contains three pickup devices. The one connected to jack 1J2 absorbs a comparison sample for the terminal AFC unit. A loop transfers to 1J3 the r-f energy for the antenna. A slot is used to obtain energy to operate r-f monitor 1M2, the combination output meter and fault relay.

Seventy mc amplifier stages 1V5 and 1V6 amplify the 70 mc signal from the receiver/modulator to raise it to the proper amplitude before injection into the transmitter mixer circuit.

R-f monitor 1M2 is an r-f output indicating meter which also acts as the transmitter fault indicating device. The r-f energy for operating 1M2 is rectified by crystal 1N21B in cavity 1Z1D. MONITOR ADJUST 1R14 controls the amount of current flowing through 1M2 to keep the meter pointer on scale. When the output of r-f amplifier 1V4 drops to a certain predetermined value a circuit is closed inside 1M2 which energizes a transmitter fault reporting relay in the service unit. The value at which the 1M2 relay reports a fault is indicated by the red pointer which can be set manually by a control knob on the front of 1M2.

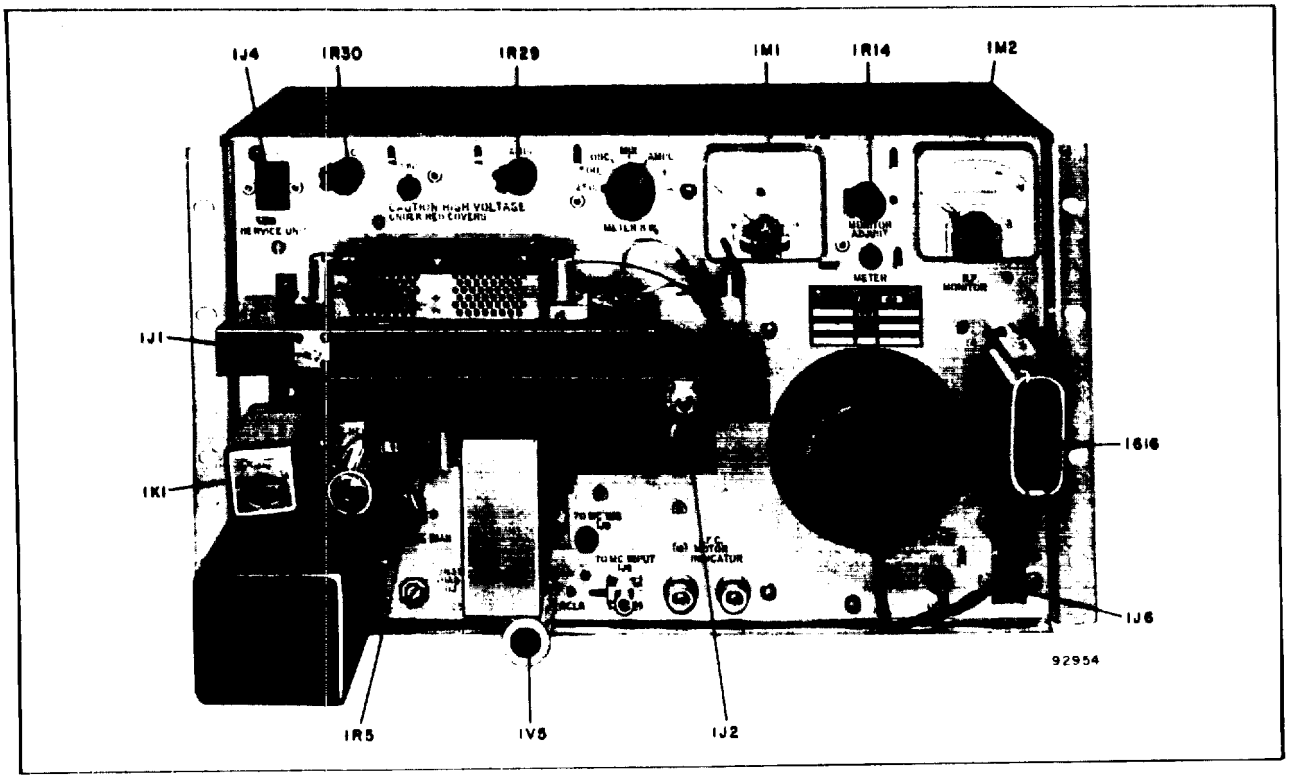

Figure T-1—Transmitter—Front View

DC amplifier 1V1, relay 1K1 and AFC motor 1B1 and associated circuits constitute the transmitter oscillator frequency control section. The following is the sequence of events that cause this equipment to function: A portion of the transmitter local oscillator output is coupled by a cable, attached to jack 1J1, to the receiver r-f mixer in the receiver/modulator unit. The transmitter oscillator frequency and the received microwave frequency determines the receiver 30 mc i-f. If the transmitter local oscillator drifts the resultant change in the receiver i-f causes a dc component to appear in the receiver 30 mc discriminator output. This dc is carried through the service unit to the transmitter jack 1J4 of the transmitter. From terminal 1 of jack 1J4 it is applied to the control grid of the 1-2-3 section of dc amplifier 12AT7 (1V1).

When the transmitter operates on the sideband above the L.O. (local oscillator) frequency, the connections to motor 1B1 are as shown in figures T-4 and T-5. (Motor 1B1 is actually two motors mounted on a single shaft. The F and B terminals shown on the schematic are the power connections to the "front" (F) and "back" (B) motors of 1B1. The "front" motor refers to the one nearest the panel.) Contact 7 of relay 1K1 is connected to the F terminal of 1B1 and contact 4 of 1K1 is connected to the B terminal of 1B1. If the receiver i-f increases for any reason, a positive dc voltage at 1V1-2 from the receiver discriminator will cause relay 1K1 to function so that 1B1 runs in a counterclockwise direction as indicated by the lighting of the + (1I2) lamp. This will turn the tuning loop in cavity 1Z1A to increase the L.O. frequency so that the receiver i-f is again 30 mc. A decrease of receiver i-f causes a negative dc voltage at 1V1-2 which will move the tuning loop in a clockwise direction, as indicated by the lighting of the − (1I1) lamp, and decrease the L.O. frequency so that the receiver i-f is again 30 mc.

For lower sideband transmitter operation the connections to 1B1 are: contact 7 of relay 1K1 is connected to the B terminal of 1B1 and contact 4 of 1K1 is connected to the F terminal of 1B1. When 1B1 is connected in this manner a positive dc voltage at 1V1-2, caused by a receiver i-f increase, will cause the 1Z1A tuning loop to turn in a clockwise direction and light the + (1I2) lamp. This will decrease the L.O. frequency until the receiver i-f is again 30 mc. A negative voltage at 1V1-2 caused by a receiver i-f decrease will cause the 1Z1A tuning loop to turn in a counterclockwise direction and light the − (1I1) lamp. This will increase the L.O. fre-

quency until the receiver i-f is again 30 mc. The dc amplifier bias control 1R5 is adjusted so that when the receiver discriminator dc output is at zero voltage the AFC motor 1B1 stops running.

In order to prevent the AFC motor 1B1 from moving the tuning loop out of position during initial installation or when servicing the station equipment, an AFC motor disabling switch has been provided. With the AFC motor switch 1S3 open (OFF) the 115 v ac to 1B1 is disconnected.

Meter Switch 1S1A in conjunction with test meter 1M1 supplies a means of making the following measurements: On the 250 and 500 positions of 1S1A, meter 1M1 registers the two B+ voltages from the power supply. On the OSC, MIX and AMPL positions of 1S1A, 1M1 measures the cathode current of the oscillator 1V2, mixer 1V3, and RF amplifier 1V4 respectively. The + and − positions of 1S1A are used when positive and negative external voltage readings are made in this and other units by means of a test lead.

The transmitter oscillator, mixer and r-f amplifier tubes are cooled by blower 1B2 and if for any reason the blower should stop, the air operated switch 1S2 breaks the ac power to their filament transformer to prevent these tubes from overheating.

The cathode circuit of oscillator 1V2 contains a current regulating circuit that prevents the cathode current of 1V2 from varying greatly from the value set by 1R43.

CONTROLS

a. The Local Oscillator Tuning Screw (Upper left) of cavity 1Z1A varies the resonant frequency of the plate circuit cavity and so determines the frequency of the oscillator. (Turning the screw out increases the resonant frequency of the cavity. This applies to all four of the transmitter cavity tuning screws.)

b. The Local Oscillator Cathode Tuning Screw (Lower left) of cavity 1Z1B varies the resonant frequency of the cathode cavity of the local oscillator and mixer cathode circuits. This tuning control has only a negligible effect on the oscillator frequency.

c. The Mixer Plate Tuning Screw (Upper right) of cavity 1Z1C varies the resonant frequency of the mixer tuning cavity. It is tuned either to the local oscillator frequency plus the 70 mc i-f carrier or to the local oscillator frequency minus the 70 mc i-f carrier in accordance with the system plan.

d. The RF Amplifier Tuning Screw (Lower right) of the cavity 1Z1D varies the resonant frequency of the plate tuning cavity. It is tuned to the mixer output frequency.

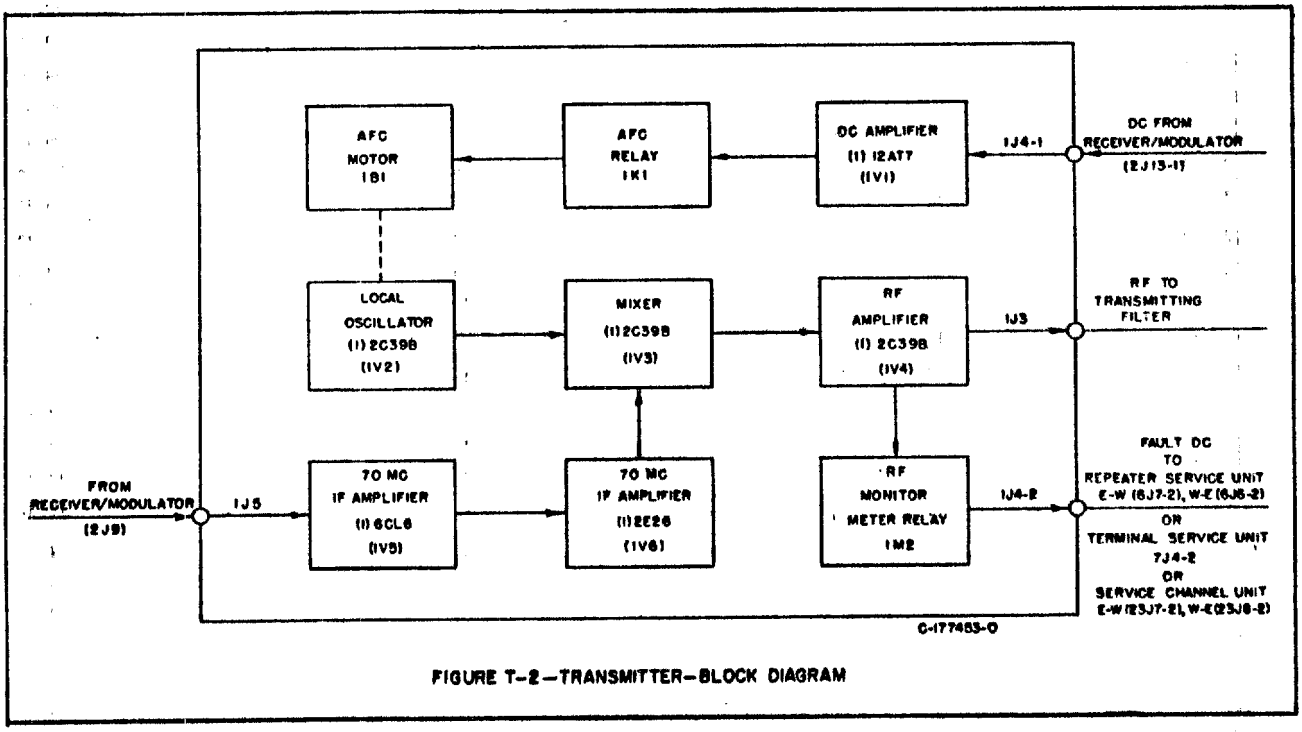

FIGURE T-2—TRANSMITTER—BLOCK DIAGRAM

Figure T-2—Transmitter—Block Diagram

e. The OSC control (1R30) is a screwdriver adjusting potentiometer which adjusts the voltage across transistor 1Q2.

f. The AMPL control (1R29) is a screwdriver adjusted potentiometer which controls the cathode current of the r-f amplifier tube 1V4 by varying its cathode bias.

g. The MONITOR ADJUST control (1R14) is a screwdriver adjusted potentiometer that controls the amount of rectified r-f output from the r-f amplifier plate cavity which flows thru RF MONITOR 1M2. It is set so that the indicator of 1M2 remains on scale. This control is adjusted in conjunction with the setting of the red pointer on RF MONITOR 1M2.

h. The METER SW (1S1) allows various current and voltage readings of the transmitter and associated units to be observed on test meter 1M1.

Position 250 measures 250 v dc B+ from the power supply. (1000 volts full scale)
Position 500 measures 825 v dc B+ from the power supply. (1000 volts full scale)
Position OSC measures the cathode current of r-f oscillator 1V2. (200 milliamps full scale)
Position MIX measures the cathode current of mixer 1V3. (200 milliamps full scale)
Position AMPL measures the cathode current of r-f amplifier 1V4. (200 milliamps full scale)
*Position + measures positive voltages. (200 microamps full scale)
*Position − measures negative voltages (200 microamps full scale)

* From test points in this and other units by means of a test lead connected to the METER jack.

i. The DC AMPL BIAS control (1R5) varies the cathode bias of the 6-7-8 section of dc amplifier 1V1, the AFC relay control tube.

j. The Test Meter (1M1) (to the right of the meter switch) is used in conjunction with meter switch 1S1 to measure various circuit values in the transmitter unit and, by means of a plug-in test lead, to make current measurements in the other units.

k. METER pinjack (1J7) is the test lead connection when test meter 1M1 is used to measure voltage and current values in associated units.

l. The RF MONITOR r-f meter and relay (1M2), a combination r-f output meter and fault relay, gives a relative indication of r-f carrier output and functions as a fault reporting relay when the r-f output reaches a predetermined low value.

m. The L.O. (local oscillator) coaxial cable terminal (1J1) is used for supplying a portion of the local oscillator energy to the receiver r-f mixer stage.

n. The A.F.C. coaxial cable terminal (1J2) is used for transferring a portion of the transmitter output signal to the AFC mixer in the terminal AFC unit. Only used for terminal stations.

o. The 70 MC INPUT coaxial cable terminal (1J5) is the input connection for the coaxial cable carrying the 70 mc i-f signal from the receiver/-modulator.

p. The A.F.C. MOTOR INDICATOR (lamps 1I1 and 1I2) show when the AFC motor is running and in which direction. When the motor is correcting the local oscillator frequency, one of the lamps is lit and when the frequency correction is complete the lamp is extinguished.

q. The A.F.C. MOTOR SWITCH 1S3 is used for opening the 115 v ac line to AFC motor 1B1 to disable it during installation or servicing.

r. The 70 MC INPUT signal jack 1J9 is used for checking the 70 mc signal input level from the receiver/modulator.

s. The AFC LOOP INDICATOR shows the position of the AFC tuning loop in the local oscillator cavity. The pointer, when moved, changes the angle of the loop in the cavity. When the pointer is at the 0 position, the loop is at approximately 45° from the vertical, the correct position of the loop in the cavity.

t. The 2N339 BIAS ADJ. potentiometer (1R43) adjusts the bias of transistor 1Q1 which controls the oscillator 1V2 cathode current.

u. The Test Point (1J10) is provided for connecting meter 1M1 across the oscillator 1V2 cathode circuit when peaking the oscillator.

INITIAL ADJUSTMENT

The following is the procedure for tuning MM-26A Transmitters (MI-31132-2C) containing the new oscillator cathode current regulator circuit. Substitute this procedure for the transmitter tuning in the system book when the system tuning instructions do not specifically provide instructions titled *"Oscillator Tuning MM-26A"*.

Oscillator Tuning

Set the 2N339 BIAS ADJ. control (1R43) one half turn from its full counterclockwise position. Place the meter switch (1S1) on the "+" position and connect one end of the test lead to meter pin jack 1J7 and the other to pin jack 1J10. Turn "on" the 500 v switch of the power supply and after warmup, turn the oscillator tuning plug (lower left) for maximum meter tuning indication. This meter indication is not a measurement of the current flow in the cathode circuit (oscillator activity) but is used strictly as a tuning indication.

If the cathode current does not change when turning the cathode tuning screw, the tube is not oscillating. If this should happen, turn 1R43 fully clockwise.

Turn the oscillator tuning plug (lower left) for maximum meter tuning indication.

Turn the meter selector to the OSC position and adjust the 2N339 BIAS ADJ. control for a meter reading of 70 ma. The reading obtained in this measurement is the actual cathode current of the oscillator stage.

MAINTENANCE

General Notes

If the transmitter power output is decreasing the following notes may facilitate isolating the difficulty:

a. First, check the 70 mc drive to the transmitter mixer by turning off the 500 volts supply. The "MIX" reading should be greater than 35 ma. (The 40 ma figure listed in the INITIAL ADJUSTMENT section of the system instructions is the expected minimum for new tubes.) The reading obtained on 1M1 when 1J9 is connected to 1J7 should be at least 30μa.

If the "MIX" reading is below 35 ma check the 70 mc signal voltage input from the receiver/modulator. The 30 μa reading at 1J9 is equivalent to 1 volt at 1V5-3. If this value is less than 1 volt the receiver/modulator is not delivering enough drive to the transmitter and the correction will have to be made in the receiver/modulator unit. If the input to 1V5 is sufficient, check both 1V5 and 1V6 tubes and replace if necessary.

b. Second, check the quality of the oscillator tube by noting how much its cathode current increases as the tube changes from a non-oscillating to an oscillating condition. (The bottom oscillator slug can be detuned to stop oscillation.) The current should increase by approximately 3:1 for a good tube. If the increase is less than 1.5:1 the tube should be replaced.

c. If the oscillator is supplying adequate drive to the mixer tube cathode current (meter switch at MIX) should drop to roughly 50% of the normal value when the 70 mc cable is removed. If this decrease is of the order of only 10%, a point of marginal operation has been reached. The mixer cathode current is determined in part by the oscillator drive. If the mixer cathode current exceeds 125 ma, the oscillator cathode current should be reduced.

d. A poor 2C39B amplifier is frequently revealed by an inability to get adequate cathode current, with sufficient drive from the mixer, as the cathode variable resistor (1R29) is decreased. When less than 75 ma of "AMPL" cathode current is obtained with 1R29 set at minimum the amplifier tube should probably be replaced.

e. If the transmitter fails completely it may be caused by a defective 2C39B electron tube or the breakdown of capacitors 1C19, 1C23 or 1C26. If one of these capacitors is shorted due to dust and moisture or if certain elements of tubes 1V2, 1V3 or 1V4 becomes shorted, then the 500 v B+ power is short circuited and fuse 5F16 in the power supply will be blown.

f. Variable resistor 1R14 "MONITOR ADJUST" is used to adjust the operating point of meter relay 1M2. A suggested setting of 1R14 is that which will give a 1M2 reading of 150 μa. Set the red hand of 1M2 at the meter reading below which the transmitter output should not fall. Meter/Relay 1M2 will report a transmitter fault to the service unit when the transmitter output falls to this value.

g. Both the transmitter AFC motor and the blower motor have lifetime lubricated bearings. The grease sealed bearings of the blower section of the blower-motor should be inspected periodically and replaced with new bearings when necessary. The normal life of the bearings is between three and four years.

h. If the blower motor runs but the tube filaments do not burn, check the operation of the air operated switch 1S2.

Transmitter AFC Circuit

As d-c amplifier tube 1V1 ages, D.C. AMPL. BIAS potentiometer 1R5 must be readjusted to keep the i-f frequency of the receiver/modulator centered at 30 mc. When the range of adjustment provided by 1R5 is no longer adequate to center the i-f, 1V1 must be replaced.

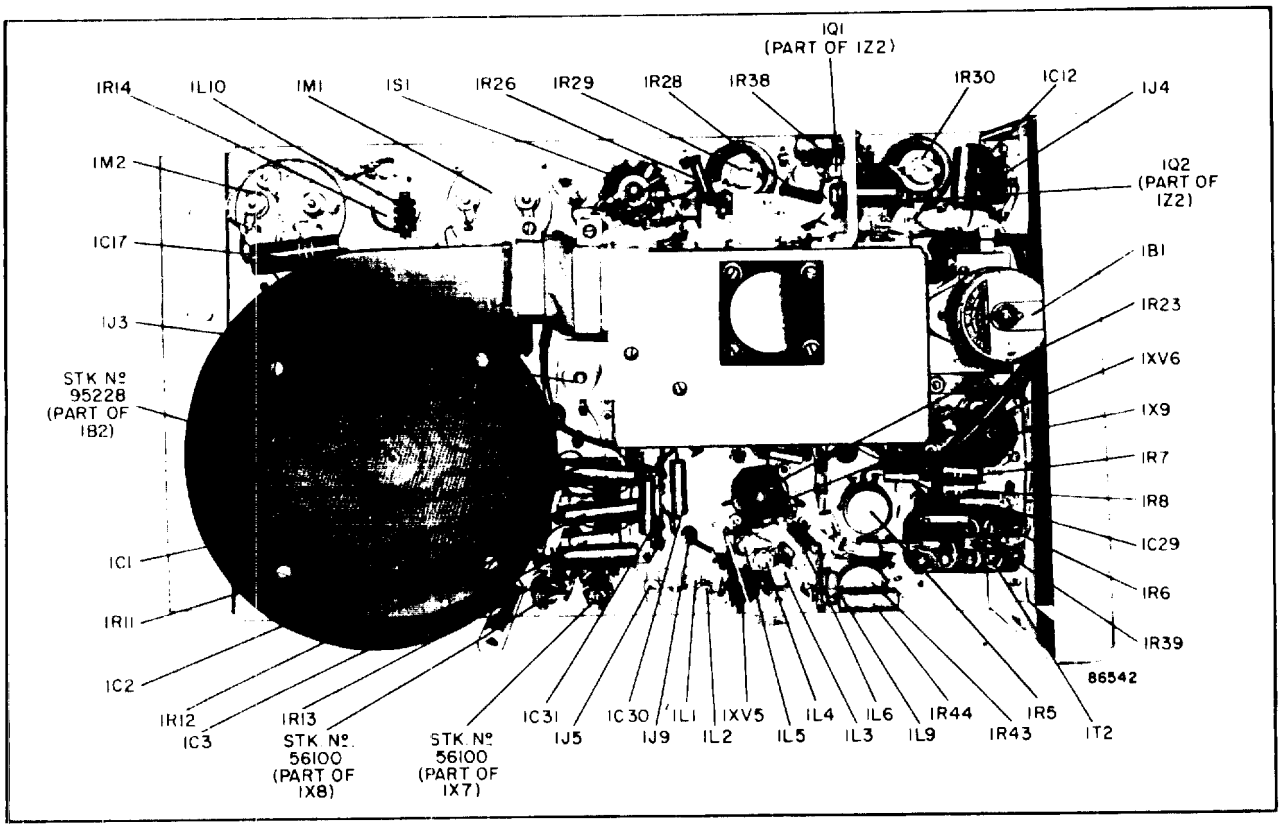

Figure T-3—Transmitter—Rear View

Transmitter AFC Circuit Test

If the transmitter AFC circuit fails to respond to the dc correction signals from the discriminator of the receiver/modulator, the d-c amplifier may be the cause.

Check the sensitivity of the d-c amplifier 1V1 as follows (with the AFC motor 1B1 connected for upper side band operation as shown in Figure T-4):

1. Apply + .15 volts to pin 1 of jack 1J4 and ground. This voltage should cause the AFC motor indicator light, marked +, to light.

2. Apply − .15 volts to pin 1 of jack 1J4 and ground. This voltage should cause the AFC motor indicator light, marked −, to light.

3. Check the action of the clutch by moving the loop indicator by hand.

70 MC Circuit Alignment

NOTE: The test items specified in this alignment procedure refer to the test equipment items listed in the test equipment tables of the system instructions.

a. Apply the output of the 70 mc sweep generator (test item 18), with markers, to 1V6-5. (Tube shields of 2E26 and 6CL6 and the shields of transformer 1T1 must be in place.)

b. Connect the CRO (test item 4) to the cathode of 1V3 (2C39-B mixer tube).

c. Turn on the 115 volt a-c and 250 volt d-c supplies.

d. Adjust 1T1 and 1C33 for correct alignment. The response is that of an over-coupled double-tuned circuit with peaks approximately 12 megacycles apart.

NOTE: Should it be impossible to align this stage the reason is, most likely, that either of the two circuits is not tuned to 70 mc ± 1 mc. The resonant frequencies of the two circuits are easily checked with test item 12.

e. Connect the CRO to 1V6-3, connect the sweep generator to 1V5-2, and adjust 1L3, 1L4, and 1L5 for the correct response. The response curve is nearly flat with 3 db points 10 mc apart.

f. Connect the CRO to 1V5-8, connect the sweep generator to Pin No. 1 of the 70 mc amplifier 2V11

and connect the 70 MC OUTPUT jack 2J9 to the 70 MC INPUT jack 1J5 of the transmitter and adjust 1L1 and 1L2 for the correct response.

g. Connect the CRO to the cathode of 1V3 to check the overall response.

IMPORTANT

If the repair of cavity 1Z1 is required and if the removal of the mounting assemblies of electron tubes 1V2, 1V3 and 1V4 is necessary it is important that these parts be very carefully positioned upon reassembly. If the opening in the plates of these assemblies are not in line the tubes are likely to be broken when inserted. For proper installation of these tube mounting assemblies use the following instructions:

1. Install the ring assembly in the holes of the partition between the two cavity sections and tighten the screws.

2. Install the assembly that holds the cathode and filament terminals (small end) of the tubes but leave the mounting screws very loose.

3. Install the assembly that holds the plate (large end) terminal of the tubes but leave the mounting screws loose.

4. Insert a 2C39-B tube allowing all parts to center about the tube. Tighten all screws with the tube in place. Remove the tube.

The installation of tubes 1V2, 1V3 and 1V4 may now be done without danger of damage to the tubes.

TYPICAL TRANSMITTER VOLTAGES AND METER READINGS

The following are approximate voltages existing between the indicated tube pins and ground as measured with a voltohmyst with 100,000 ohms in series with the measuring probe. All voltages are dc unless otherwise noted.

Tube	*Type*	*Function*	*Pin 1*	*Pin 2*	*Pin 3*	*Pin 4*	*Pin 5*	*Pin 6*	*Pin 7*	*Pin 8*	*Pin 9*
1V1	12AT7	DC ampl.	90	0	1.8	0	0	250	90	92	6.3 ac
1V5	6CL6	70 mc. ampl.	2.3	0	117	0	6.3 ac	228	2.3	117	—
1V6	2E26	70 mc. ampl.	15	0	185	15	0	15	6.3 ac	—	Plate cap 250

The following are typical readings of test meter 1M1 for the various positions of "METER SW" 1S1:

250v— 50 μa
500v—200 μa } Meter connected as a voltmeter with a 1000 volt full scale reading

OSC—70 ma

MIX.—110 ma max., 60 ma min.

AMPL.—120 ma max.

\+
— } In these positions the meter is connected to an external probe for use in testing other MM-26A unit quantities

REPLACEMENT PARTS LIST

Symbol No.	Stock No.	Drawing No.	Description
1B1	94203	8832092-1	Motor: timing motor and gear unit, (AFC Drive) 110 v. 60 cy.
1B2	216921	741276-4	Blower: 115/230 v. 50/60 cy., 3300 RPM
	94204	741276-2	Motor: for blower 1B2, 115/230 v. 50/60 cy. 3300 RPM, pt. of 1B2
	95228	8830675-2	Bearing: ball, for blower motor, pt. of 1B2
			CAPACITORS:
1C1 to 1C3		735715-363	Paper, 0.01 μf ±10%, 1000 v.
1C4	94189	984002-121	Mica, 1000 $\mu\mu$f ±10%, 500 v
1C5 to 1C8	94190	449696-1	Ceramic, 820 $\mu\mu$f +100 -0%, 500 v.
1C9	95319	735717-633	Ceramic, 220 $\mu\mu$f ±20%, 500 v
1C10, 1C11	94190	449696-1	Ceramic, 820 $\mu\mu$f +100 -0%, 500 v.
1C12		735715-25	Paper, 0.1 μf ±20%, 200 v.
1C13 to 1C15	203760	8828585-3	Ceramic, feed thru type, 1000 $\mu\mu$f +80 -20%, 500 v.
1C16	208503	990195-2	Paper, 4 μf ±10%, 330 v. ac, for blower motor
1C17			Not Used
1C18 to 1C27			Part of 1Z1
1C28	94190	449696-1	Ceramic, 820 $\mu\mu$f +100 -0%, 500 v.
1C29		735715-175	Paper, 0.1 μf ±10%, 400 v.
1C30, 1C31		735715-119	Paper, 0.033 μf ±20%, 400 v.
1C32	93716	984015-218	Ceramic, 22 $\mu\mu$f ±5%, 500 v.
1C33	203761	8819214-1	Variable, ceramic trimmer, 4.5/28 $\mu\mu$f
1C34	95319	734717-633	Ceramic, 220 $\mu\mu$f ±20%, 500 v
1C35			Not Used
1C36	214667	442901-154	Electrolytic, 100 μf, 50 v.
1C37, 1C38	215957	984002-661	Silver mica, button type, 25 $\mu\mu$f ±10%, (part of 1Z1)
1CR1	67876	1N21B	Rectifier: germanium diode 1N21B
1CR2	203954	1N48	Rectifier: germanium diode 1N48
1I1, 1I2	101857	872291-9	Lamp: neon, starting volts 65 v. ac, 90 v. dc, bay base
1J1, 1J2	94205	456989-501	Connector: female, coaxial, chassis mounted. (part of 1Z1)
1J3	203972	460231-503	Connector: female, coaxial, chassis mounted with 7/32" lg. loop & teflon beads (RF Output)
1J4	28507	181494-3	Connector: male, 6 contact, chassis mounted
1J5	94205	8845666-1	Connector: female, coaxial, chassis mounted
1J6	28507	181494	Connector: male, 6 contact, chassis mounted
1J7	93678	742565-1	Connector: pin jack, for 0.080 dia. pin
1J8	18534	181494-4	Connector: female, 6 contact, chassis mounted
1J9, 1J10	93678	742565-1	Connector: pin jack, for 0.080 dia. pin
1K1	94206	8834407-1	Relay: differential polarized, S.P., 3 pos. null seeking coils each 3500 ohm, octal plug-in type
1L1	94207	629132-522	Coil: adj. iron core, 3 turns of 0.0126 dia. wire on form 0.920 lg.
1L2	94208	629132-524	Coil: adj. iron core, 5 turns of 0.0126 dia. wire on form 0.920 lg.
1L3	94245	629132-517	Coil: adj. iron core, 11 turns of 0.0126 dia. wire on form 0.920 lg.
1L4	94239	629132-527	Coil: adj. iron core, 15 turns of 0.0126 dia. wire on form 0.920 lg.
1L5	94211	629132-520	Coil: adj. iron core, 6 turns of 0.0126 dia. wire on form 0.920 lg.
1L6	94040	8834424-501	Reactor: iron core 2.5 microhenry
1L7	217800	941524-245	Reactor: RF choke, 6.8 microhenry
1L8			Part of 1Z1
1L9	217800	941524-245	Reactor: RF choke, 6.8 microhenry
1L10	98426	8886161-6	Reactor: RF choke, 2.5 mh, 50 ma
1L11	57239	8898641-2	Reactor: RF choke, 0.84 microhenry, 1000 ma
	208637	883209 1-2	Core: tuning, iron threaded type, 1/4-28 x 3/8" lg. with fibre nut and spring washer. for (1L1, 1L2, 1L3, 1L4, 1L5)
1M1	94213	456986-1	Meter: dc, 0-200 ma
1M2	94214	8834409-1	Meter: dc, special, 0-200 ma, with switch and contact locking winding, single contact low limit adj.

Symbol No.	Stock No.	Drawing No.	Description
1P1	28454	181494-2	Connector: male, 6 contact, cable mounting type
1Q1	216985	2N339	Transistor: Type 2N339
1Q2	216986	2N158	Transistor: power, type 2N158
			RESISTORS:
			Fixed, Composition, Unless Otherwise Specified
1R1		82283-35	4.7 meg. ±20%, ½ w
1R2			Not Used
1R3		82283-139	150 ohm ±5%, ½ w
1R4		82283-89	180,000 ohm ±10%, ½ w
1R5	94039	737829-30	Variable, comp., 5000 ohm ±10%, 2 w.
1R6		99126-72	6800 ohm ±10%, 2 w
1R7, 1R8		99126-194	30,000 ohm ±5%, 2 w.
1R9		99126-209	120,000 ohm ±5%, 2 w
1R10			Not Used
1R11 to 1R13	59282	8825410-54	Wire wound, 50 ohm ±10%, 10 w.
1R14	203068	737829-32	Variable, comp. 50,000 ohm ±10%, 2 w.
1R15		82283-193	27,000 ohm ±5%, ½ w.
1R16		82283-64	1500 ohm ±10%, ½ w
1R17		82283-50	100 ohm ±10%, ½ w.
1R18		82283-68	3300 ohm ±10%, ½ w
1R19		90496-79	27,000 ohm ±10%, 1 w.
1R20		82283-13	1000 ohm ±20%, ½ w.
1R21		82283-64	1500 ohm ±10%, ½ w.
1R22		82283-58	470 ohm ±10%, ½ w.
1R23		90496-82	47,000 ohm ±10%, 1 w.
1R24		82283-50	100 ohm ±10%, ½ w.
1R25		82283-74	10,000 ohm ±10%, ½ w.
1R26 to 1R28	56327	8871557-11	Wire wound, 0.66 ohm ±1%, 1 w. meter shunt
1R29, 1R30	95312	180639-8	Variable, ww, 500 ohm ±10, 25 w.
1R31			Not Used
1R32		82283-249	5.6 meg. ±5%, ½ w.
1R33		82283-50	100 ohm ±10%, ½ w.
1R34		82283-249	5.6 meg. ±5%, ½ w.
1R35, 1R36		82283-91	270,000 ohm ±10%, ½ w.
1R37		82283-74	10,000 ohm ±10%, ½ w.
1R38	94377	458572-26	Wire wound, 100 ohm ±5%, 5 w.
1R39 to 1R42			Not Used
1R43	98221	458575-105	Variable, comp., 500 ohm ±10%, 2 w.
1R44	209278	458575-89	Fixed wire wound, 20,000 ohm ±5%, 5 w.
1R45		99126-111	10 ohm ±5%, 2 w (part of 1Z2
1R46		735730-153	560 ohm ±5%, ½ w. (part of 1Z2)
1R47			Not Used
1R48		99126-115	15 ohm ±5%, 2 w. (part of 1Z2)
1R49		735730-213	180,000 ohm ±5%, ½ w. (part of 1Z2)
1S1	94193	458908-1	Switch: rotary, wafer, single section, single circuit, 7 pos., non-shorting
1S2	59479	449277-1	Switch: rotary, snap action, SPST, normally open contacts, 125 v. ac, (air interlock)
1S3	48791	187454-2	Switch: toggle, SPST, 3 amp., 250 v. ac or dc
1T1	203762	8819222-501	Transformer: RF adj. core, 70 mc
1T2	207287	469743-1	Transformer: filament
1V2 to 1V4	207832-A	2C39B	Tube: vacuum, UHF power triode
1X1	94880	984055-2	Socket: tube, 9 pin min.
1X2 to 1X4			Part of 1Z1
1X5	94880	984055-2	Socket: tube, 9 pin min.
1X6	68590	99391-1	Socket: tube, std. octal, natural phenolic
1X7, 1X8		8834425-1	Pilot light assembly
	94121		Jewel: Pilot light clear jewel only less socket & lamp
	56100		Socket: Pilot light socket only less jewel & lamp part of (1X7 & 1X8)
1X9	68590	99100-3	Socket: tube, std. octal, black phenolic

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Symbol No.	*Stock No.*	*Drawing No.*	*Description*
1Z1	213898-A	647661-502	Cavity Assembly: Transmitter, tuning range of 2450-2700 MC obtained by reversing 4 tuning cores. The following parts also stocked
	94270	8831010-1	Bushing: Textolite 0.499 O.D. x 0.470 I.D. x 0.160 lg., mixer capacitor insulating.
	94205	456989-501	Connector: female, coaxial, chassis mounted.
	207374	8903740-501	Contact: beryllium copper grid contact ring, less osc. loop, for 2C39-B tubes
	207375	8903740-502	Contact: Beryllium copper, grid contact ring, with osc. loop, for 2C39-B tubes
	207376	8903749-501	Contact: Beryllium copper, cathode contact ring, for 2C39-B tubes
	207378	8832042-2	Contact: Beryllium copper, filament contact stud, for 2C39-B tubes
	216922	750302-503	Contact: Beryllium copper, plate contact ring, for 1V4 (2C39-B with insulating ring)
	216922	750302-504	Contact: Beryllium copper, plate contact ring, for 1V2, 1V3 (2C39-B tubes) less insulating ring.
	207377	8903730-1	Core: Brass, #5/8"-24 threaded type 1-7/8" lg. overall cavity tuning
	207379	8831012-2	Insulator: Laminated phenolic, 7/8" O.D. x 0.116 I.D. x 1/16" thick with 3/16" dia. off-set hole, filament contact. Insulating for 2C39-B tubes
	94269	8831011-1	Nut: Brass, knurled, 1"-32 inside thread 3/4" I.D. opposite side 1-1/16" O.D. x 5/32" for mixer capacitor
	95395	874927-6	Nut: Brass, #5/8-24 Hox, tuning core locking
	203766	892950-3	Washer: Mica, 1/2" O.D. x 0.484 I.D. x .006 thick, filament contact insulating for 2C39-B tubes
	207380	8903734-1	Washer: Spring, Beryllium copper, 21/32" I.D. x 25/32 O.D. x .015 thick tuning core locking
1Z2		8708728-501	Current regulator assembly, not stocked complete the following parts only: Available, 1R45, 1R46, 1R48, 1R49, 1Q1, 1Q2
	214339	8825609-18	Insulator: glass cloth, 0.283 O.D. x 0.253 I.D. x 0.170 lg.
	99761	899256-6	Oil: Silicone, 1 oz. bottle
	214397	8864518-5	Washer: Plastic, 0.56 O.D. x 0.250 I.D. x .002 thick
	214398	8864518-4	Washer: Laminated phenolic, 0.62 O.D. x 0.2571 I.D. x 0.093 thick
			Miscellaneous
	94385	8832079-1	Boot: Blower, wool gabardine, 2-32/32" dia. x 2" lg.
	213901	8813040-502	Coil: A.F.C. loop and shaft assy.
	93856	185290-1	Connector: Male, pin jack, cable mtg.
	207701	888550-1	Connector: Tube cap, for 1V6
	213900	8819241-1	Contact: 2C39-B tube radiator plate, less lead
	94784	8833025-4	Cushion: AFC drive assembly mtg., rubber, supplied in bulk piece 19" lg.
	94382	8834421-1	Insulator: Textolite head, 9/32" lg. x 0.447 O.D. x 0.254 I.D. (1CR1, & 1C4 mtg.)
	30075	712336-507	Knob: Round, black bakelite, pointer type, for 1S1
	94383	8832071-501	Lever: 1S2 switch activating lever and plate assembly
	94381	8831054-1	Screw: Thumb #6-32 x 15/16" lg. overall with 13/32 dia. x 3/8" lg. knurled hd. cover plate retaining
	56359	8858642-3	Shield: Tube, 9 pin min 1-15/16" lg.
	94387	8834442-501	Spring: Helical, mtd. on plate 1-5/16" sq. blower shock mtg., 3 req'd.)
	94386	8832080-1	Strap: Steel, 0.0179 thick x 11-1/8" lg. x 1/2" wide, blower boot clamping, 2 req'd.

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NOTES:
1. DESIGNATIONS IN WIRES ARE WIRE NUMBERS AND THEIR DESTINATIONS.
2. SOLDER ALL ELECTRICAL CONNECTIONS USING ITEM 38. ALL WIRING TO BE IN ACCORDANCE WITH RCA STANDARD PRACTICE.
3. CABLE AND LACE WIRES WHERE NECESSARY USING ITEM 39.
4. WIRE NUMBERS NOT USED ARE 204, 301, 302, 312, 313, 314, 220, 221.
5. J181 IS NORMALLY CONNECTED FOR UPPER SIDEBAND OPERATION. FOR LOWER SIDEBAND OPERATION INTERCHANGE CONNECTIONS FROM J81 TO J188-6 AND J188-2.
6. BLOWER RESTRICTOR IS OUTLINED BY PHANTOM LINE AT APPROXIMATE PHYSICAL LOCATION.
7. NUMBERS IN BALLOONS REFER TO LIST OF PARTS.

WIRE TABLE					
WIRE NO (MOUNTED)	WIRE DESCRIPTION COLOR	CONDUCTOR	PS NUMBER OR DRAWING NUMBER	69-1850-505 PARTS LIST ITEM NO.	WIRE NUMBERS NOT USED
1 TO 10	WHT - BLK	7/.008	PS 805-6	101	
11 TO 20	- BLK			102	
21 TO 26	- GRN			103	
27 TO 35	- BLU			104	
36 TO 42	- RED		PS 805-6	105	
43 TO 52	- RED	7/.026	PS 805-7	106	
53 TO 62	- BRN/GRN	7/.010	PS 805-8	107	
63 TO 68	- BLU/RED	7/.010	PS 805-8	108	
70 TO 74	WHT - RED	19/.010	8837425-5	109	
100 TO 101	SHIELDED CABLE		8837810-7	96	
201 TO 230	TINNED COPPER WIRE	.032 DIA	PS 805	97	SEE NOTE 4
240 TO 241	TINNED COPPER WIRE	.032 DIA	PS 805	95	
300, 303, 319, 320	INSULATED TUBING	#22 I.D.	PS 8	94	
318	BLACK PVC TUBING	#16 I.D.	PS 8	92	

Figure T-4—Transmitter—Schematic Diagram

T-11, T-12

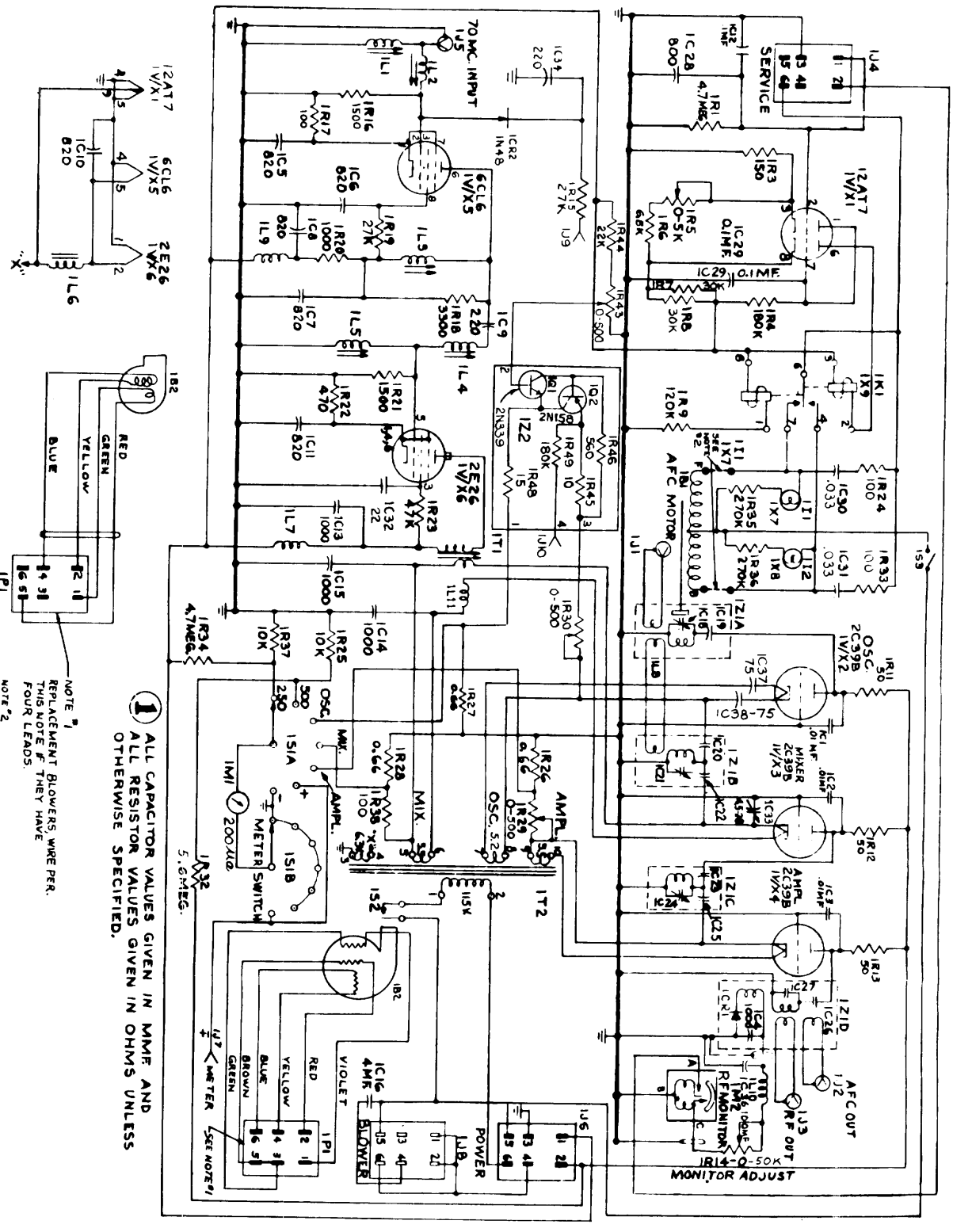

Figure T-5—Transmitter—Wiring Diagram

T-13, T-14

M

MICROWAVE COMMUNICATION EQUIPMENT

Transmitter MI-31007

- TECHNICAL DATA
- DESCRIPTION
- MAINTENANCE
- REPLACEMENT PARTS

RADIO CORPORATION OF AMERICA
ENGINEERING PRODUCTS DIVISION, CAMDEN, N. J.

PRINTED IN U. S. A.
5104

TECHNICAL DATA

Power Input:
a. Fil. Heaters and Blower. 95 watts at 115 volts—50/60 cycle A.C.
b. Plate Supply: 65 milliamps at 250 v dc
300 milliamps at 500 v dc

Frequency Range
2450-2700 megacycles

Modulated Signal Input
70 megacycle FM Signal from MI-31102-A

Modulation Bandwidth
8 mc

Total Peak Deviation
±1.5 megacycles

Transmitter Power Output
1.5 watts

Crystal

Symbol	*Type*	*Function*
1CR1	1N21B	RF Rectifier
1CR2	1N48	RF Rectifier

Tube Complement

Symbol	*Type*	*Function*
1V1	12AT7	DC Amplifier
1V2	*2C39A	Local Oscillator
1V3	*2C39A	Transmitter Mixer
1V4	*2C39A	RF Amplifier
1V5	6CL6	70 mc i-f Amplifier
1V6	2E26	70 mc i-f Amplifier
1V7	35C5	Osc. Cathode Current Regulator

* Use RCA Stock No. 207832 only.

Fuse Complement

Symbol	*Type*	*Function*
1F1	MJB 1/32 amp	Arc Indicator
1F2	MJB 1/32 amp	Arc Indicator
1F3	MJB 1/32 amp	Arc Indicator

Weight and Dimensions
Weight—25 lbs.
Height—10½"
Depth back of panel: (6" plus 1" allowance for air passage. 11" with air filter)
Depth front of panel: 4"
Width: 19" Rack Mounting

DESCRIPTION

The MI-31007 Transmitter is designed for installation in either a standard 19" open rack or cabinet and is used in both terminal and repeater stations. The transmitter unit provides a frequency modulated r-f output in the frequency range of 2450 to 2700 mc.

Transmitter MI-31007 contains the equipment to generate and amplify the microwave carrier. The oscillator frequency is determined by tuning resonant cavity 1Z1A by means of the top left tuning screw. (This and the three other cavity tuning screws are located on the cavity assembly mounted on the front panel.) This frequency is coupled directly to the mixer cathode resonant cavity 1Z1B which is tuned by the lower left tuning screw. The oscillator frequency is mixed with the 70 mc carrier from the modulator section of the receiver/-modulator unit. This 70 mc frequency modulated signal is injected into the cathode circuit of mixer tube 1V3. The resultant frequency, the sum or difference in accordance with the system plan, is fed thru mixer anode tuning cavity 1Z1C to the r-f amplifier 1V4. 1Z1C is tuned to the output frequency of the mixer stage by the upper right cavity tuning screw. The r-f amplifier stage is tuned to the same frequency as the mixer output. This tuning is done in resonant cavity 1Z1D by the lower right cavity tuning screw. (All cavity tuning screws are turned out for an increase in frequency).

The plate tuning cavity 1Z1D of the r-f amplifier contains three pickup devices. The one connected to jack 1J2 absorbs a comparison sample for the terminal AFC unit. A loop transfers to 1J3 the r-f energy for the antenna. A slot is used to obtain energy to operate r-f monitor 1M2, the combination output meter and fault relay.

Seventy mc amplifier stages 1V5 and 1V6 amplify the 70 mc signal from the receiver/modulator to raise it to the proper amplitude before injection into the transmitter mixer circuit.

R-f monitor 1M2 is an r-f output indicating meter which also acts as the transmitter fault indicating device. The r-f energy for operating 1M2 is rectified by crystal 1N21B in cavity 1Z1D. MONITOR ADJUST 1R14 controls the amount of current flowing through 1M2 to keep the meter pointer on scale. When the output of r-f amplifier 1V4 drops to a certain predetermined value a circuit is closed inside 1M2 which energizes a transmitter fault reporting relay in the service unit. The

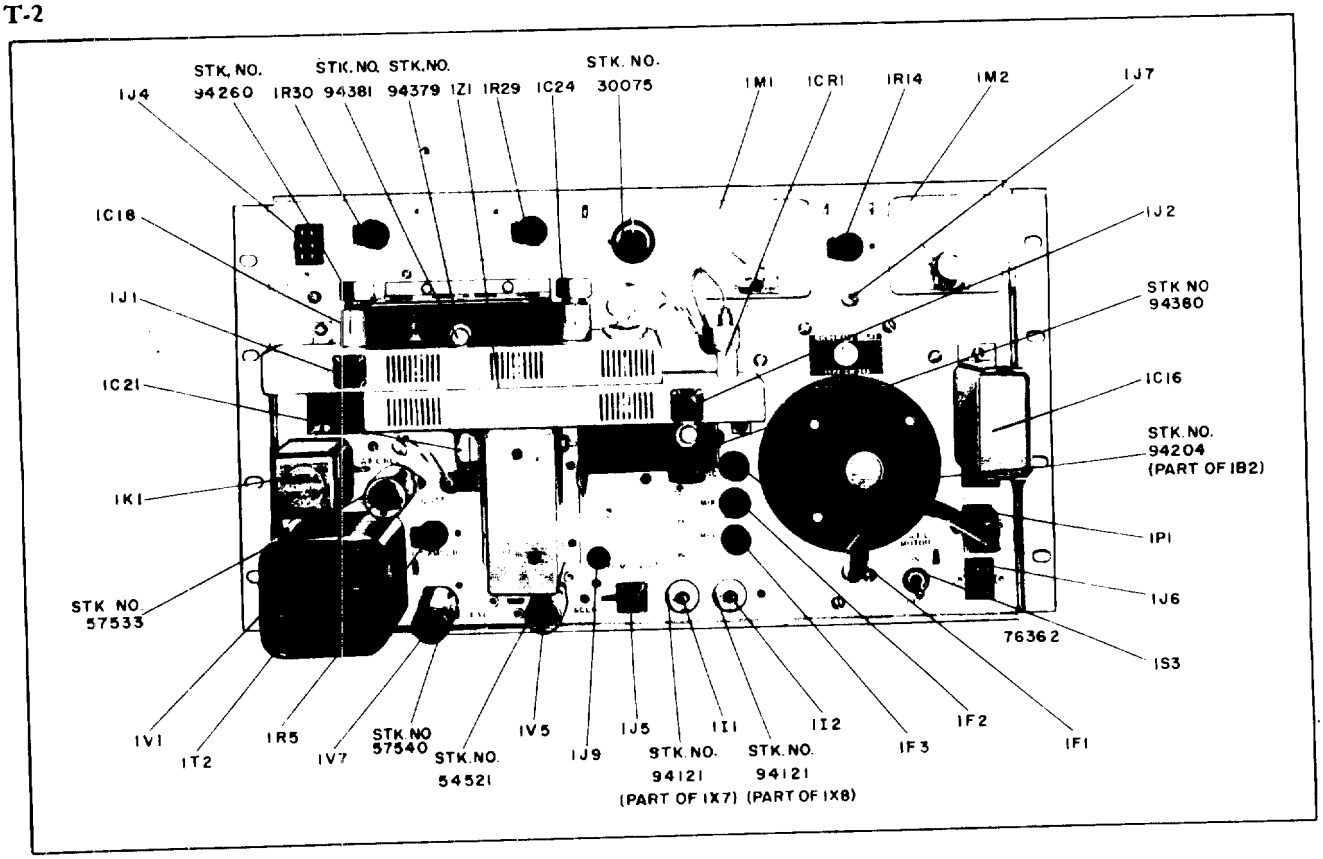

Figure T-1—Transmitter, MI-31007—Front View

value at which the 1M2 relay reports a fault is indicated by the red pointer which can be set manually by a control knob on the front of 1M2.

DC amplifier 1V1, relay 1K1 and AFC motor 1B1 and associated circuits constitute the transmitter oscillator frequency control section. The following is the sequence of events that cause this equipment to function: A portion of the transmitter local oscillator output is coupled by a cable, attached to jack 1J1, to the receiver r-f mixer in the receiver/-modulator unit. The transmitter oscillator frequency and the received microwave frequency determines the receiver 30 mc i-f. If the transmitter local oscillator drifts the resultant change in the receiver i-f causes a dc component to appear in the receiver 30 mc discriminator output. This dc is carried through the service unit to the transmitter jack 1J4 of the transmitter. From terminal 1 of jack 1J4 it is applied to the control grid of the 1-2-3 section of dc amplifier 12AT7 (1V1).

When the transmitter operates on the sideband above the L.O. (local oscillator) frequency, the connections to motor 1B1 are as shown in figures T-3 and T-4. (Motor 1B1 is actually two motors mounted on a single shaft. The F and B terminals shown on the schematic are the power connections to the "front" (F) and "back" (B) motors of 1B1. The "front" motor refers to the one nearest the panel.) Contact 7 of relay 1K1 is connected to the F terminal of 1B1 and contact 4 of 1K1 is connected to the B terminal of 1B1. If the receiver i-f increases for any reason, a positive dc voltage at 1V1-2 from the receiver discriminator will cause relay 1K1 to function so that 1B1 runs in a counterclockwise direction as indicated by the lighting of the + (1I2) lamp. This will turn the tuning loop in cavity 1Z1A to increase the L.O. frequency so that the receiver i-f is again 30 mc. A decrease of receiver i-f causes a negative dc voltage at 1V1-2 which will move the tuning loop in a clockwise direction, as indicated by the lighting of the − (1I1) lamp, and increase the L.O. frequency so that the receiver i-f is again 30 mc.

For lower sideband transmitter operation the connections to 1B1 are: contact 7 of relay 1K1 is connected to the B terminal of 1B1 and contact 4 of 1K1 is connected to the F terminal of 1B1. When 1B1 is connected in this manner a positive dc volt-

age at 1V1-2, caused by a receiver i-f increase, will cause the 1Z1A tuning loop to turn in a clockwise direction and light the + (1I2) lamp. This will decrease the L.O. frequency until the receiver i-f is again 30 mc. A negative voltage at 1V1-2 caused by a receiver i-f decrease will cause the 1Z1A tuning loop to turn in a counterclockwise direction and light the – (1I1) lamp. This will increase the L.O. frequency until the receiver i-f is again 30 mc. The dc amplifier bias control 1R5 is adjusted so that when the receiver discriminator dc output is at zero voltage the AFC motor 1B1 stops running.

In order to prevent the AFC motor 1B1 from moving the tuning loop out of position during initial installation or when servicing the station equipment, an AFC motor disabling switch has been provided. With the AFC Motor switch 1S3 open (OFF) the 115 v ac to 1B1 is disconnected.

Meter Switch 1S1A in conjunction with test meter 1M1 supplies a means of making the following measurements: On the 250 and 500 positions of 1S1A, meter 1M1 registers the two B+ voltages from the power supply. On the OSC, MIX and AMPL positions of 1S1A, 1M1 measures the cathode current of the oscillator 1V2, mixer 1V3, and RF amplifier 1V4 respectively. The + and – positions of 1S1A are used when positive and negative external voltage readings are made in this and other units by means of a test lead.

The transmitter oscillator, mixer and r-f amplifier tubes are cooled by blower 1B2 and if for any reason the blower should stop, the air operated switch 1S2 breaks the ac power to their filament transformer to prevent these tubes from overheating.

The plate circuit of tubes 1V1, 1V2 and 1V3 each contain a $\frac{1}{32}$ amp. fuse and 150 ohm resistor in parallel with the 50 ohm plate resistor. Should arc-over occur in any of these tubes, evidence of this will be indicated by a blown 5F16 fuse in the power supply. The faulty tube may readily be detected by checking each of the arc indicating fuses 1F1 (OSC), 1F2 (MIXER) and 1F3 (AMPL.).

The cathode current of the oscillator 1V2 contains a 35C5 ballast tube. This is a current regulating device which prevents the cathode current of 1V2 from varying greatly from the value set by 1R30. If the cathode current of 1V2 tends to increase or decrease appreciably the resistance of the filament of 1V7 will increase and decrease accordingly to maintain the current through it at a nearly constant value.

CONTROLS

a. The Local Oscillator Tuning Screw (Upper left) of cavity 1Z1A varies the resonant frequency of the plate circuit cavity and so determines the frequency of the oscillator. (Turning the screw out increases the resonant frequency of the cavity. This applies to all four of the transmitter cavity tuning screws.)

b. The Local Oscillator Cathode Tuning Screw (Lower left) of cavity 1Z1B varies the resonant frequency of the cathode cavity of the local oscillator and mixer cathode circuits. This tuning control has only a negligible effect on the oscillator frequency.

c. The Mixer Plate Tuning Screw (Upper right) of cavity 1Z1C varies the resonant frequency of the mixer tuning cavity. It is tuned to either the sum frequency (local oscillator frequency +70 mc i-f or the difference (local oscillator frequency –70 mc i-f.

d. The RF Amplifier Tuning Screw (Lower right) of the cavity 1Z1D varies the resonant frequency of the plate tuning cavity. It is tuned to the mixer output frequency.

e. The OSC control (1R30) is a screwdriver adjusted potentiometer which controls the cathode current of the oscillator tube 1V2 by varying its cathode bias.

f. The AMPL control (1R29) is a screwdriver adjusted potentiometer which controls the cathode current of the r-f amplifier tube 1V4 by varying its cathode bias.

g. The MONITOR ADJUST control (1R14) is a screwdriver adjusted potentiometer that controls the amount of rectified r-f output from the r-f amplifier plate cavity which flows thru RF MONITOR 1M2. It is set so that the indicator of 1M2 remains on scale. This control is adjusted in conjunction with the setting of the red pointer on RF MONITOR 1M2.

h. The METER SW (1S1) allows various current and voltage readings of the transmitter and associated units to be observed on test meter 1M1.

- Position 250 measures 250 v dc B+ from the power supply. (1000 volts full scale)
- Position 500 measures 500 v dc B+ from the power supply. (1000 volts full scale)
- Position OSC measures the cathode current of r-f oscillator 1V2. (200 milliamps full scale)

Position MIX measures the cathode current of mixer 1V3. (200 milliamps full scale)

Position AMPL measures the cathode current of r-f amplifier 1V4. (200 milliamps full scale)

*Position + measures positive voltages. (200 microamps full scale)

*Position -- measures negative voltages. (200 microamps full scale)

* From test points in this and other units by means of a test lead connected to the METER jack.

i. The DC AMPL BIAS control (1R5) varies the cathode bias of the 6-7-8 section of dc amplifier 1V1, the AFC relay control tube.

j. The Test Meter (1M1) (to the right of the meter switch) is used in conjunction with meter switch 1S1 to measure various circuit values in the transmitter unit and, by means of a plug-in test lead, to make current measurements in the other units.

k. METER pinjack (1J7) is the test lead connection when test meter 1M1 is used to measure voltage and current values in associated units.

l. The RF MONITOR r-f meter and relay (1M2), a combination r-f output meter and fault relay, gives a relative indication of r-f carrier output and functions as a fault reporting relay when the r-f output reaches a predetermined low value.

m. The L.O. (local oscillator) coaxial cable terminal (1J1), is used for supplying a portion of the local oscillator energy to the receiver r-f mixer stage.

n. The A.F.C. coaxial cable terminal (1J2) is used for transferring a portion of the transmitter output signal to the AFC mixer in the terminal AFC unit. Only used for terminal stations.

o. The 70 MC INPUT coaxial cable terminal (1J5) is the input connection for the coaxial cable carrying the 70 mc i-f signal from the receiver/-modulator.

p. The A.F.C. MOTOR INDICATOR (lamps 1I1 and 1I2) show when the AFC motor is running and in which direction. When the motor is correcting the local oscillator frequency, one of the lamps is lit and when the frequency correction is complete the lamp is extinguished.

q. The A.F.C. MOTOR SWITCH 1S3 is used for opening the 115 v ac line to AFC motor 1B1 to disable it during installation or servicing.

r. The 70 MC INPUT signal jack 1J9 is used for checking the 70 mc signal input level from the receiver/modulator.

s. The AFC LOOP INDICATOR shows the position of the AFC tuning loop in the local oscillator cavity. The pointer, when moved, changes the angle of the loop in the cavity. When the pointer is at the 0 position, the loop is at approximately 45° from the vertical, the correct position of the loop in the cavity.

MAINTENANCE

General Notes

If the transmitter power output is decreasing the following notes may facilitate isolating the difficulty:

a. First, check the 70 mc drive to the transmitter mixer by turning off the 500 volts supply. The "MIX" reading should be greater than 35 ma. (The 40 ma figure listed in the INITIAL ADJUSTMENT section of the system instructions is the expected minimum for new tubes.) The reading obtained on 1M1 when 1J9 is connected to 1J7 should be at least 30μa.

If the "MIX" reading is below 35 ma check the 70 mc signal voltage input from the receiver/modulator. The 30 μa reading at 1J9 is equivalent to 1 volt at 1V5-3. If this value is less than 1 volt the receiver/modulator is not delivering enough drive to the transmitter and the correction will have to be made in the receiver/modulator unit. If the input to 1V5 is sufficient, check both 1V5 and 1V6 tubes and replace if necessary.

b. Second, check the quality of the oscillator tube by noting how much its cathode current increases as the tube changes from a non-oscillating to an oscillating condition. (The bottom oscillator slug can be detuned to stop oscillation.) The current should increase by approximately 3:1 for a good tube. If the increase is less than 1.5:1 the tube should be replaced. The oscillator cathode current of a good tube in the oscillating condition should be at least 70 ma with 1R30 at the minimum position.

c. If the oscillator is supplying adequate drive to the mixer the mixer tube cathode current (meter

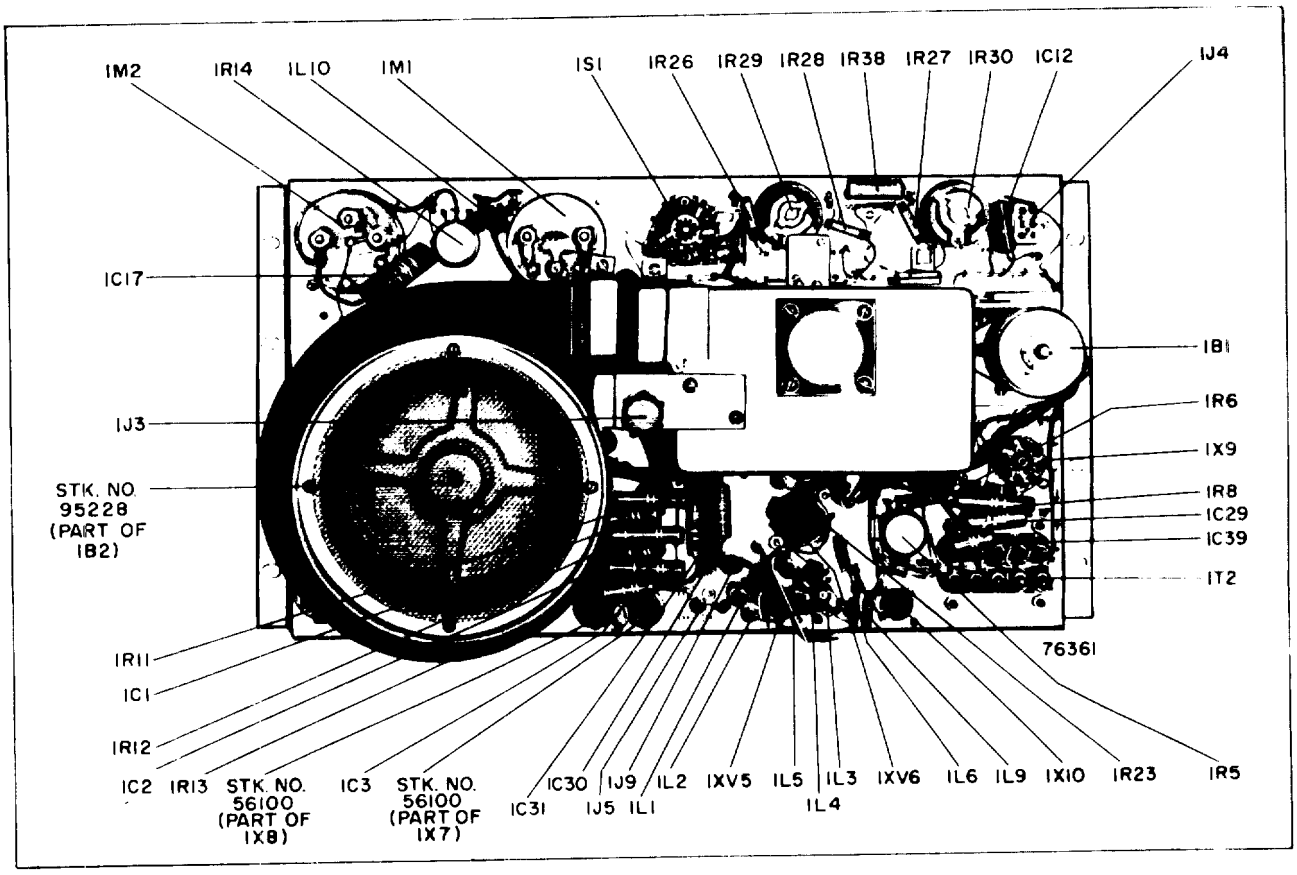

Figure T-2—Transmitter, MI-31007—Rear View

switch at MIX) should drop to roughly 50% of the normal value when the 70 mc cable is removed. If this decrease is of the order of only 10%, a point of marginal operation has been reached. The mixer cathode current is determined in part by the oscillator drive. If the mixer cathode current exceeds 125 ma, the oscillator cathode current should be reduced.

d. A poor 2C39A amplifier is frequently revealed by an inability to get adequate cathode current, with sufficient drive from the mixer, as the cathode variable resistor (1R29) is decreased. When less than 75 ma of "AMPL" cathode current is obtained with 1R29 set at minimum the amplifier tube should probably be replaced.

e. If the transmitter fails completely it may be caused by a defective 2C39A electron tube or the breakdown of capacitors 1C19, 1C23 or 1C26. If one of these capacitors is shorted due to dust and moisture or if certain elements of tubes 1V2, 1V3 or 1V4 become shorted, then the 500 v B+ power is short circuited and fuse 5F16 in the power supply will be blown. The tube circuit at fault can readily be found by noting which of the arc indicating fuses 1F1, 1F2 or 1F3 is blown.

f. Variable resistor 1R14 "MONITOR ADJUST" is used to adjust the operating point of meter relay 1M2. A suggested setting of 1R14 is that which will give a 1M2 reading of 150 μa. Set the red hand of 1M2 at the meter reading below which the transmitter output should not fall. Meter Relay 1M2 will report a transmitter fault to the service unit when the transmitter output falls to this value.

g. Both the transmitter AFC motor and the blower motor have lifetime lubricated bearings. The grease sealed bearings of the blower section of the blower-motor should be inspected periodically and replaced with new bearings when necessary. The normal life of the bearings is between two and three years.

h. If the blower motor runs but the tube filaments do not burn, check the operation of the air operated switch 1S2.

Transmitter AFC Circuit

As d-c amplifier tube 1V1 ages, D.C. AMPL. BIAS potentiometer 1R5 must be readjusted to keep the i-f frequency of the receiver/modulator centered at 30 mc. When the range of adjustment provided by 1R5 is no longer adequate to center the i-f, 1V1 must be replaced.

Transmitter AFC Circuit Test

If the transmitter AFC circuit fails to respond to the dc correction signals from the discriminator of the receiver/modulator, the d-c amplifier may be the cause.

Check the sensitivity of the d-c amplifier 1V1 as follows (with the AFC motor 1B1 connected for upper side band operation as shown in Figure T-3):

1. Apply + .15 volts to pin 1 of jack 1J4 and ground. This voltage should cause the AFC motor indicator light, marked +, to light.

2. Apply – .15 volts to pin 1 of jack 1J4 and ground. This voltage should cause the AFC motor indicator light, marked –, to light.

3. Check the action of the clutch by moving the loop indicator by hand.

70 MC Circuit Alignment

NOTE: The test items specified in this alignment procedure refer to the test equipment items listed in the test equipment tables of the system instructions.

a. Apply the output of the 70 mc sweep generator (test item 18), with markers, to 1V6-5. (Tube shields of 2E26 and 6CL6 and the shields of transformer 1T1 must be in place.)

b. Connect the CRO (test item 4) to the cathode of 1V3 (2C39A mixer tube).

c. Turn on the 115 volt a-c and 250 volt d-c supplies.

d. Adjust 1T1 and 1C33 for correct alignment. The response is that of an over-coupled double-tuned circuit with peaks approximately 12 megacycles apart.

NOTE: Should it be impossible to align this stage the reason is, most likely, that either of the two circuits is not tuned to 70 mc ±1 mc. The resonant frequencies of the two circuits are easily checked with test item 12. Some adjustment of the coupling may be necessary to get the peak separation to fall between 10 and 14 mc.

TYPICAL TRANSMITTER VOLTAGES AND METER READINGS

The following are approximate voltages existing between the indicated tube pins and ground as measured with a voltohmyst with 100,000 ohms in series with the measuring probe. All voltages are dc unless otherwise noted.

Tube	*Type*	*Function*	*Pin 1*	*Pin 2*	*Pin 3*	*Pin 4*	*Pin 5*	*Pin 6*	*Pin 7*	*Pin 8*	*Pin 9*
1V1	12AT7	DC ampl.	90	0	1.8	0	0	250	90	92	6.3 ac
1V5	6CL6	70 mc. ampl.	2.3	0	117	0	6.3 ac	228	2.3	117	—
1V6	2E26	70 mc. ampl.	15	0	185	15	0	15	6.3 ac	—	Plate cap 250

The following are typical readings of test meter 1M1 for the various positions of "METER SW" 1S1:

250v— 50 μa
500v—100 μa } Meter connected as a voltmeter of roughly 1000 volt full scale reading

OSC—70 ma

MIX.—100 ma max., 60 ma min.

AMPL.—100 ma max.

\+ } In these positions the meter is connected to an external probe for use in testing other MM-26A
— } unit quantities

e. Connect the CRO to 1V6-3, connect the sweep generator to 1V5-1, and adjust 1L3, 1L4, and 1L5 for the correct response. The response curve is nearly flat with 3 db points 10 mc apart.

f. Connect the CRO to 1V5-8, connect the sweep generator to Pin No. 1 of the 70 mc amplifier 2V11 and connect the 70 MC OUTPUT jack 2J9 to the 70 MC INPUT jack 1J5 of the transmitter and adjust 1L1 and 1L2 for the correct response.

g. Connect the CRO to the cathode of 1V3 to check the overall response.

IMPORTANT

If the repair of cavity 1Z1 is required and if the removal of the mounting assemblies of electron tubes 1V2, 1V3 and 1V4 is necessary it is important that these parts be very carefully positioned upon reassembly. If the opening in the plates of these assemblies are not in line the tubes are likely to be broken when inserted. For proper installation of these tube mounting assemblies use the following instructions:

1. Install the ring assembly in the holes of the partition between the two cavity sections and tighten the screws.

2. Install the assembly that holds the cathode and filament terminals (small end) of the tubes but leave the mounting screws very loose.

3. Install the assembly that holds the plate (large end) terminal of the tubes but leave the mounting screws loose.

4. Insert a 2C39A tube allowing all parts to center about the tube. Tighten all screws with the tube in place. Remove the tube.

The installation of tubes 1V2, 1V3 and 1V4 may now be done without danger of damage to the tubes.

REPLACEMENT PARTS LIST

TRANSMITTER UNIT MI-31007

Symbol No.	*Description*	*Drawing No.*	*Stock No.*
1B1	Motor, ac, low power geared, 110 v., 60 cycle, 2 amps., reversible, 1/10 r.p.m. timing motor and gear unit	8832092-1	94203
1B2	Blower	741276-4	
	Motor, for blower 1B2, 50/60 cycle, 115/230, 0.8/0.4 A, 3300 r.p.m.	741276-2	94204
	Bearing, ball, for blower motor	8830675-2	95228
1C1 to 1C3	Capacitor, fixed, paper, 0.01 mf, ±10%, 1000 v.d.c.	735715-363	73565
1C4	Capacitor, fixed, silver mica, button type, 1000 mmf ±10%, 500 v.dc	984002-121	94189
1C5 to 1C8	Capacitor, fixed, ceramic, 820 mmf –0% +100%, 500 v.dc	449696-1	94190
1C9	Capacitor, fixed, ceramic, 220 mmf ±20%, 500 v.dc	735717-633	75611
1C10, 1C11	Capacitor, fixed, ceramic, 820 mmf –0% +100%, 500 v.dc. Same as 1C5	449696-1	94190
1C12	Capacitor, fixed, paper, 0.1 mf ±20%, 500 v.dc	735715-25	73784
1C13 to 1C15	Capacitor, fixed, ceramic, feed through, 1000 mmf +80% –20%, 500 v.dc	8828585-3	203760
1C16	Capacitor, fixed, paper, 4 mf, 330 v.ac, for blower motor	8832059-1	19464
1C17	Capacitor, fixed, paper, 0.47 mf, ±20%, 200 v.dc	735715-33	73787
1C18 to 1C27, incl.	Capacitor, part of 1Z1.		
1C28	Capacitor, fixed, ceramic 820 mmf–0% +100%, 500 v.dc. Same as 1C5	449696-1	94190
1C29	Capacitor, fixed, paper, 0.1 mf ±10%, 400 v.dc	735715-175	73551
1C30, 1C31	Capacitor, fixed, paper, 0.033 mf ±20%, 400 v	735715-119	73552
1C32	Capacitor, fixed, ceramic, 22 mmf ±5%, 500 v	984015-218	93716
1C33	Capacitor, variable, ceramic trimmer, 4.5 to 28 mmf	8819214-1	203761
1C34	Capacitor, fixed, ceramic, 220 mmf ±20%, 500 v.dc. Same as 1C9	735717-633	95319
1CR1	Rectifier, crystal diode, 1N21B	Type 1N21B	67876
1CR2	Rectifier, crystal diode, 1N48	Type 1N48	203954
1F1 to 1F3	Fuse, cartridge, 1/32 amp., 250 v	8851771-17	69417
1I1, 1I2	Lamp, neon, starting volts, 65 v.ac, 90 v.dc, min. bay base	872291-9	91749
1J1, 1J2	Connector, female, concentric, chassis mounted with ¼" long cavity loop. (part of 1Z1)	456989-501	94248
1J3	Connector, female, concentric, chassis mtg., with loop and teflon beads	460231-503	203972
1J4	Connector, male, 6 contact, chassis mtg.	181494-3	28507

Symbol No.	Description	Drawing No.	Stock No.
1J5	Connector, female, co-axial, chassis mtg.	8845666-1	94205
1J6	Connector, male, 6 contact, chassis mtg. Same as 1J4	181494-3	28507
1J7	Connector, pin jack for 0.080 dia. pin	742565-1	93678
1J8	Connector, female, 6 contact, chassis mtg.	181494-4	18534
1J9	Connector, pin jack for 0.080 dia. pin. Same as 1J7	742565-1	93678
1K1	Relay, differential polarized, s.p., 3 pos. null seeking, coils each 3500 ohms, oper. at 1.5 ma, release at 0.3 ma, octal plug-in type	8834407-1	94206
1L1	Coil, iron core, adj. 3 turns of 0.0126 dia. wire on form 0.920 lg.	629132-522	94207
1L2	Coil, iron core, adj. 5 turns of 0.0126 dia. wire on form 0.920 lg.	629132-524	94208
1L3	Coil, iron core, adj. 11 turns of 0.0126 dia. wire on form 0.920 lg.	629132-517	94245
1L4	Coil, iron core, adj. 15 turns of 0.0126 dia. wire on form 0.920 lg.	629132-527	94239
1L5	Coil, iron core, adj. 6 turns of 0.0126 dia. wire on form 0.920 lg.	629132-520	94211
1L6	Reactor, iron core, 2.4 microhenry	8834424-501	94040
1L7	Reactor, r-f choke, 7.5 microhenry, 275 ma	459688-76	205050
1L8	Part of 1Z1.		
1L9	Reactor, r-f choke, 7.5 microhenry, 275 ma. Same as 1L7	459688-76	205050
1L10	Reactor, r-f choke, 2.5 mh, 50 ma	8886161-6	98426
1L11	Reactor, r-f choke, 0.84 millihenry, 1000 ma	8898641-2	57239
1M1	Meter, d-c, 0-200 microampere	456986-1	94213
1M2	Meter, d-c, special, micrometer, 0-200 microampere with switch and contact locking winding, single contact, low limit adjustable	8834409-1	94214
1P1	Connector, male, 6 contact, cable mtg. type	181494-2	28454
1R1	Resistor, fixed, composition, 4.7 meg ±20%, ½ w	82283-35	30931
1R2	Not used.		
1R3	Resistor, fixed, composition, 150 ohm ±5%, ½ w	82283-139	502115
1R4	Resistor, fixed, composition, 180,000 ohm ±10%, ½ w	82283-89	502418
1R5	Resistor, variable, composition, 5000 ohm ±10%, 2 watts, screw driver slotted shaft	737829-30	94039
1R6	Resistors, fixed, composition, 6800 ohm ±10%, 2 w	99126-72	502268
1R7	Not used.		
1R8	Resistor, fixed, wire wound, 15,000 ohm ±10%, 10 w	844908-35	52016
1R9	Resistor, fixed, composition, 120,000 ohm ±5%, 2 w	99126-209	522412
1R10	Not used.		
1R11 to 1R13	Resistor, fixed, wire wound, 50 ohm ±10%, 10 w	8825410-54	59282
1R14	Resistor, variable, composition, 25,000 ohm ±10%, 2 w., screw driver slotted shaft	737829-31	94192
1R15	Resistor, fixed, composition, 27,000 ohm ±5%, ½ w	82283-193	502327
1R16	Resistor, fixed, composition, 1500 ohm ±10%, ½ w	82283-64	502215
1R17	Resistor, fixed, composition, 100 ohm ±10%, ½ w	82283-50	502110
1R18	Resistor, fixed, composition, 3300 ohm ±10%, ½ w	82283-68	30733
1R19	Resistor, fixed, composition, 27,000 ohm ±10%, 1 w	90496-79	512327
1R20	Resistor, fixed, composition, 1000 ohm ±20%, ½ w	82283-13	502210
1R21	Resistor, fixed, composition, 1500 ohm ±10%, ½ w	82283-64	502215
1R22	Resistor, fixed, composition, 470 ohm ±10%, ½ w	82283-58	30499
1R23	Resistor, fixed, composition, 47,000 ohm ±10%, 1 w	90496-82	512347
1R24	Resistor, fixed, composition, 100 ohm ±10%, ½ w	82283-50	502110
1R25	Resistor, fixed, composition, 10,000 ohm ±10%, ½ w	82283-74	502310
1R26 to 1R28	Resistor, fixed, wire wound, 0.66 ohm ±1%, 1 w. Meter Shunt 0.66, 200 ma	8871557-11	56327
1R29, 1R30	Resistor, variable, wire wound, 500 ohm ±10%, 25 w., screw driver slotted shaft	180639-8	95312
1R31	Not used.		
1R32	Resistor, fixed, composition, 4.7 meg ±5%, ½ w	82283-247	30931
1R33	Resistor, fixed, composition, 100 ohm ±10%, ½ w. Same as 1R24	82283-50	502110
1R34	Resistor, fixed, composition, 4.7 meg ±5%, ½ w. Same as 1R32	82283-247	30931
1R35, 1R36	Resistor, fixed, composition, 270,000 ohm ±10%, ½ w	82283-91	502427

Symbol No.	Description	Drawing No.	Stock No.
1R37	Resistor, fixed, composition, 10,000 ohm ±10%, ½ w. Same as IR25	82283-74	502310
1R38	Resistor, fixed, wire wound, 100 ohm ±5%, 5 w	449680-10	94377
1R39	Resistor, fixed, wire wound, 0.38 ohm ±10%, 5 w	458592-1	97911
1R40 to 1R42	Resistor, fixed, composition, 150 ohm ±10%, 1 w	90496-52	512115
1S1	Switch, rotary, wafer, single section, 1 circuit, 7 pos., non-shorting	458908-1	94193
1S2	Switch, rotary, snap action, s.p.s.t., normally open contacts, 125 v.ac	449277-1	59479
1S3	Switch, toggle, s.p.s.t., 3 amps, 250 v.ac or dc	187454-2	48791
1T1	Transformer, r-f adj. iron core, 70 mc	8819222-501	203762
1T2	Transformer, filament	949374-1	94216
1V2, 1V3, 1V4	Tube, u.h.f., triode	.....	207832
1X1	Socket, 9 pin, tube	984055-2	56333
1X2 to 1X4	Part of 1Z1.		
1X5	Socket, tube, 9 pin. Same as 1X1	984055-2	56333
1X6	Socket, tube std, octal, moulded mica filled bakelite	99391-1	68590
1X7, 1X8	Light, indicator	8834425-1	
	Socket, inductor light socket only less jewel and lamp	Pt. of 8834425-1	56100
	Jewel, indicator light clear jewel only less socket and lamp	Pt. of 8834425-1	94121
1X9	Socket, tube, std, octal, black phenolic compound	87156-1	31319
1X10	Socket, tube, 7 pin min.	99370-2	53539
1X11 to 1X13	Holder, fuse, panel mtg. type	8813054-1	97912
1Z1	Cavity Assembly not stocked complete	629572-501	
	The following parts only available:		
	Bushing, textolite, 0.499 O.D. x 0.470 I.D. x 0.160 lg. (mixed capacitor insulator)	8831010-1	94270
	Connector, female, concentric, chassis mtg. with ¼" lg. cavity loop	456989-501	94248
	Contact, beryllium copper contact ring, 45/64" dia. x ⅜", mounted on brass plate 1 9/32" dia. including osc. loop (2C39A grid contact for 1V2)	8816648-502	203763
	Contact, beryllium copper contact ring, 45/64" dia. x ⅜", mounted on brass plate 1 9/32" dia. less osc. loop (2C39A grid contact for 1V3 and 1V4)	8816648-501	203764
	Contact, beryllium copper contact ring, 1 5/64" dia. x 2 1/64" high, mounted on 2 9/32" dia. brass plate (2C39A plate contact for 1V2, 1V3, 1V4)	750302-501	203765
	Contact, flared beryllium copper, mounted on copper plate 1¼" x 1⅞" (2C39A filament for 1V/X3, 1V/X2, 1V/X4)	8832042-1	94271
	Contact, flared beryllium copper contact and bushing (2C39A cathode for 1V/X2, 1V/X3, 1V/X4)	8832070-501	94265
	Nut, mixer capacitor, brass knurled, 1"-32 inside thread ¾" I.D., opposite side, 1 1/16" O.D. x 5/32	8831011-1	94269
	Screws, cavity tuning, brass ¾" hex head, 2¼" overall length	8832041-1	94260
	Washer, mica, ½" O.D. x 0.484 I.D. x 0.006 thick (filament contact insulating for 1V/X2, 1V/X3, 1V/X4)	892950-3	203766
	Miscellaneous		
	Boot, blower, wool gabardine, 2 31/32" dia. x 2" lg.	8832079-1	94385
	Coil, air core, 1 turn of 0.508 dia. copper wire, afc tuning loop	8836018-501	94384
	Connector, tube cap	888550-1	53409
	Cushion, afc drive assembly mounting rubber ⅞" lg. x ¼" x 5/16" with 1/16" wide x ⅛" deep channel. 4 req'd. (piece supplied 19" lg.)	8833025-4	94784
	Insulator, textolite, 9/32" lg. x 0.447 O.D. x 0.254 I.D. (1CR1 and 1C4 mtg.)	8834421-1	94382
	Knob, round black bakelite pointer type (for 1S1)	712336-507	30075
	Lever, 1S2 switch activating lever and plate assembly	8832071-501	94383
	Shield, tube, 7 pin min.	99369-3	57540
	Shield, tube, 9 pin min. 1 15/16" lg.	8858642-3	57533
	Spring, helical mounted on plate, 1 5/16" sq. (blower shock mtg., 3 req'd)	8834442-501	94387
	Strap, steel, 0.0179 thick x 11⅛" lg. x ½" wide (blower boot clamping)	8832080-1	94386

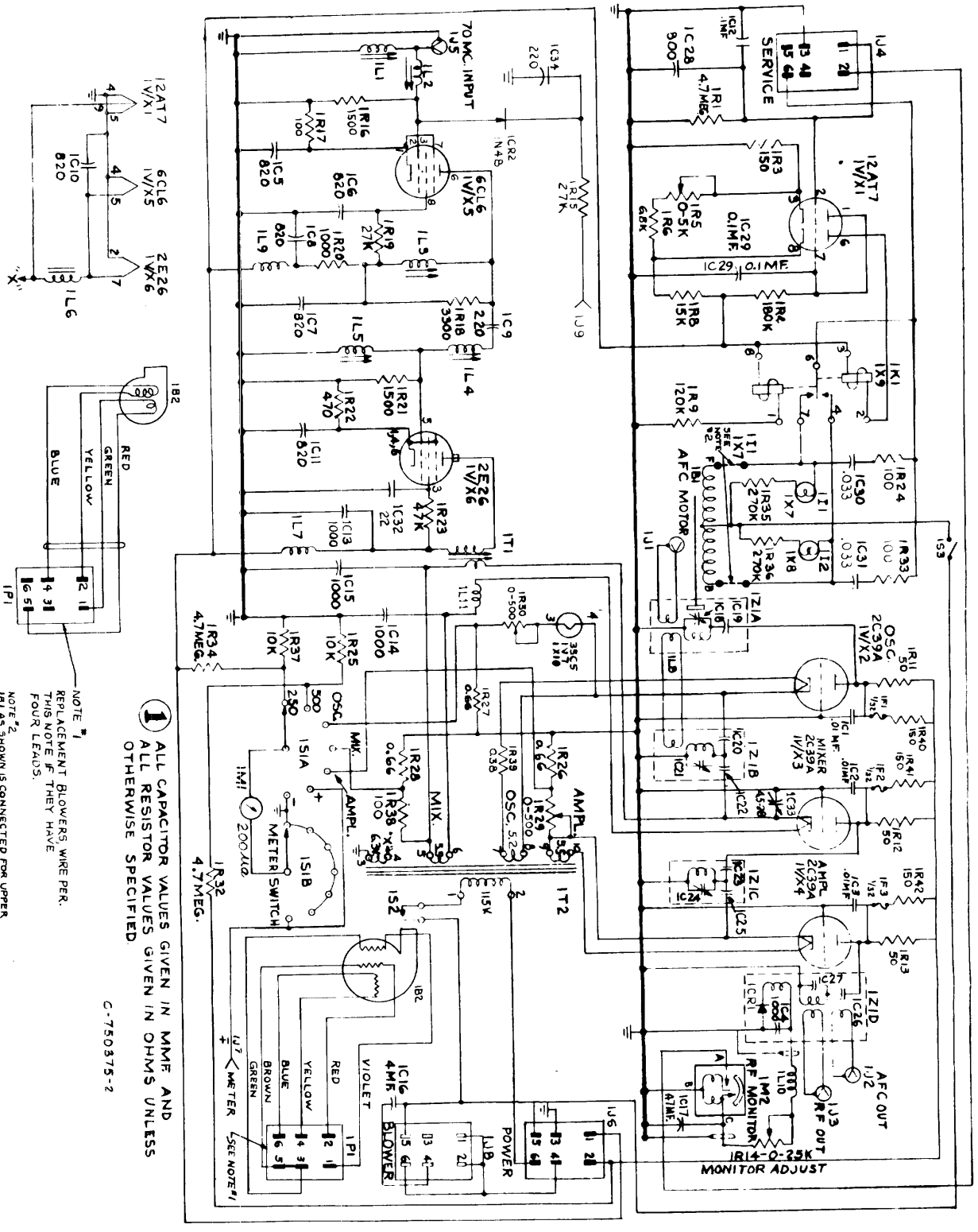

Figure T-3—Transmitter, MI-31007—Schematic Diagram

NOTES
1 DESIGNATIONS IN WIRE: ARE WIRE NUMBERS AND THEIR DESTINATIONS
2 SOLDER ALL ELECTRICAL CONNECTIONS USING ITEM 98. ALL WIRING TO BE IN ACCORDANCE WITH RCA STANDARD PRACTICE 99
3 CABLE AND LACE WIRES WHERE NECESSARY USING ITEM 99
4 WIRE NUMBERS NOT USED ARE 203,204, 207, 208, 212, 213, 214, 220, 223, 225, 226, 227 & 228
5 181 IS SHOWN CONNECTED FOR UPPER SIDEBAND OPERATION. FOR LOWER SIDEBAND OPERATION INTERCHANGE CONNECTIONS FROM 181 TO 1188-6 AND 1188-2
6 BLOWER ASSEMBLY IS OUTLINED BY PHANTOM LINE AT APPROXIMATE PHYSICAL LOCATION

WIRE NO (INCLUSIVE)	WIRE TABLE DESCRIPTION COLOR	CONDUCTOR	DRAWING NUMBER	882032-502 PARTS LIST ITEM NO	WIRE NUMBERS NOT USED
1 TO 8	WHT	7/00		100	
9 TO 20	BLK			101	
22 TO 26	GRN			102	
30 TO 36	BLU			101	
39 TO 40				104	
43 TO 47	YEL			105	
48 TO 53	RED			106	
54 TO 63	BRN/RED	10/00		107	
64 TO 68	BLU/RED	6/00		108	
70 TO 77	WHT/RED			109	
100 TO 101	SHIELDED CABLE	7/00		110	
201 TO 230	TINNED COPPER WIRE	19/34		96	SEE NOTE 4
240 TO 244	BLACK VARNISHED TUBING	7/32 I.D.		97	
300 TO 319, 320	BLACK INSULATING TUBING	7/64 I.D.		95	
1/8				92	

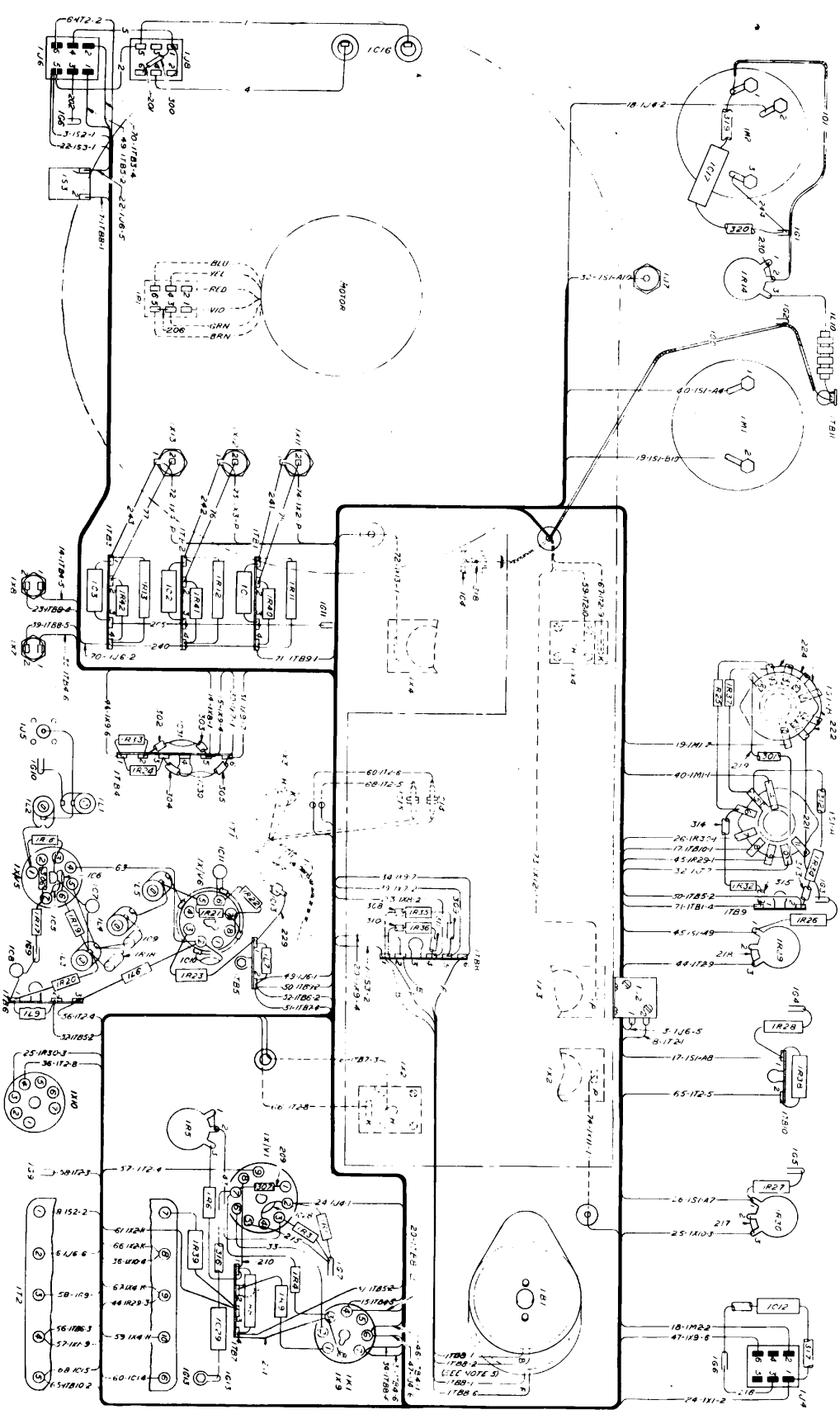

Figure T-4—Transmitter, MI-31007—Connection Diagram

M T-13, T-14

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